

# PC PRO

## RASPBERRY Pi 5

Why this £59 powerhouse could be your next PC



REVEALED Top security threats in 2024

# LUXURY TABLETS

From £160 to £2,000+

- Every major brand
- Brilliant iPad rivals
- Best for every budget



ISSUE 352

BONUS SOFTWARE CODE G2GT9C7H

## M3 MacBook Pro 14/16in

Every new model & chip



## Lenovo Legion Go

Stunning handheld Windows 11 PC

# FREE!

Claim your six full products worth £214

See page 66

## Barnacle Goose [Branta Leucopsis]

*Barnacle geese migrate twice a year, sometimes travelling over 3,000 miles in search of warmer climates.*

 **FireSwitch**®  
HOSTED PBX 2.2



## Beat the Big Switch Off

**Free migration to FireSwitch hosted telephony**

**Flexible pricing for small and medium sized business**

### FireSwitch Hosted PBX 2.2

The Big Switch Off means that all-IP Cloud telephony is no longer a choice, but a necessity. That's why it's important to choose the right alternative for your business.

Our latest fully featured hosted VoIP telephone system, with mobile and desktop softphones, has been designed to provide a resilient, cost effective and highly flexible solution.

Additional benefits include an online management portal, call recording and business analytics, making monitoring and management easier than ever. Connecting people and sites together with next generation communication.

All this, with free and simple migration.

#### Key Features

- Softphone
- Call Recording
- Reporting
- Management Portal
- Inbuilt Call Resiliency

 **FireSwitch**®  
HOSTED PBX 2.2

**Sales 020 7501 3333 • Partner Services 020 7501 3150**  
**Innovative • Flexible • Reliable • Supportive • Cost Effective**

## HIGHLIGHTS THIS MONTH

Full contents overleaf

### REVIEW OF THE MONTH

p46

#### M3 chips and new MacBook Pro

While it's true that the M3 chips don't set benchmarks on fire quite like the M1 and M2 managed, this is another substantial upgrade for Apple's silicon. It's no surprise that the MacBook Pro family debuts the M3 in all its guises, and we're fortunate to have tested the M3, M3 Pro and M3 Max version across the 14in and 16in iterations.

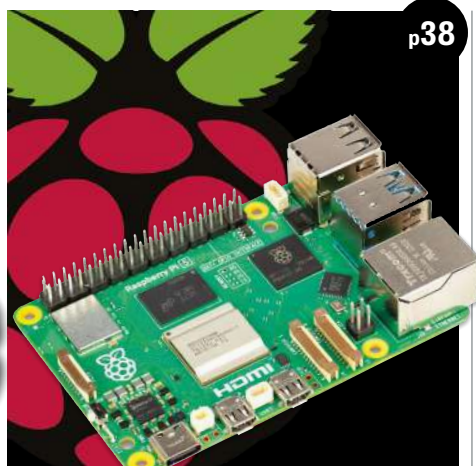
Again, no great revelations here: simply that many people's favourite power laptops have become that much slicker. And more expensive. Find out our verdicts from p46.



p26

### GIFT IDEAS OF THE MONTH

What do you buy a techie who probably already has everything? We supplement this year's *PC Pro* podcast Hot Hardware winners with a sprinkling of festive gift ideas.



p38

### COMPUTER OF THE MONTH

Rather than simply review the Raspberry Pi 5, we challenged Nik Rawlinson to use it at his main computer. Is it fast enough? Fully featured enough? Find out from p38.



p34 & p104

### SECURITY THREATS OF NEXT YEAR

Here's one prediction for 2024: security threats aren't going away. In this two-parter, Nik Rawlinson covers the threats for consumers and Davey Winder looks at business security.



p123

### PERSON OF THE MONTH

#### Frank Gasking

We have to take our virtual hat off to Frank: he has devoted years to digging out details, images and the actual code for the long list of games that were made but never released. This is his story.

### THE LABS IN ONE NUMBER

What if we could give you a choice: 17 tablets or only one? Because the most expensive version of the brilliant iPad Pro costs 17 times as much as the cheapest, Honor's Pad X9. There are good reasons to choose both, not to mention the 11 other tablets we review this month.



p76



## p26 30 SCORCHING HOT GIFT IDEAS FOR TECHIES

# PC PRO

## RASPBERRY Pi 5

Why this £59 powerhouse could be your next PC



p38

REVEALED Top security threats in 2024

p34

## p76 LUXURY TABLETS

From £160 to £2,000+

- Every major brand
- Brilliant iPad rivals
- Best for every budget



p46

p56

### M3 MacBook Pro 14/16in

Every new model & chip



### Lenovo Legion Go

Stunning handheld Windows 11 PC

**FREE!**

Claim your six full products worth £214

See page 66

### REGULARS

- |                     |                       |
|---------------------|-----------------------|
| 7 Editor's letter   | 108 Subscriptions     |
| 14 The A-List       | 129 Next month        |
| 24 Readers' letters | 130 One last thing... |

### BRIEFING

#### 10 NASA patches probes a solar system away

US space agency provides exceedingly long-distance tech support to the Voyager space probes.

#### 11 The smart meter switch-off

The decline of 3G is bad news for the nation's smart meters.

#### 12 What did the Bletchley Park AI summit actually achieve?

The big names of AI and government were there, but will it make any difference? James O'Malley investigates.

### VIEWPOINTS

#### 20 Dick Pountain

There are compelling arguments for Android becoming as widespread on laptops and PCs as it is on phones.

#### 21 Nicole Kobie

The latest Pixel phone can borrow a smile from another photo, but real memories are better than AI ones.

#### 22 Barry Collins

AI assistants are not only making a real difference, they're even making Barry less miserable in the process.

### FEATURES

#### 26 Hot hardware of the year

We pick 20+ of the hottest bits of kit and software from this year's PC Pro podcast.

#### 34 How you're most likely to be hacked or infected in 2024

Nik Rawlinson explores how to protect yourself from the most common attacks and exploits in the coming year.

#### 38 Raspberry Pi 5: your next desktop PC for £59

The lightweight, British-made Pi is perfect for everyday desktop duties. We explain how to get started.

#### 42 Run Windows on your Apple Silicon Mac for free

Boot Camp may have got the boot, but you can still run Windows apps on macOS. Darien Graham-Smith explains.

### THE NETWORK

#### 104 How to protect your business in 2024

Davey Winder reveals the biggest threats that hit businesses in 2023 and what's likely to happen next year.

## Real World Computing

#### 110 Jon Honeyball

What can be done with a corrupt USB drive full of irreplaceable photos?

#### 113 Lee Grant

Lee predicts chaos for those who attempt a VoIP transition without a plan.

#### 116 Rois Ni Thuama

Be warned: quantum computing has become weaponised technobabble.

#### 118 Davey Winder

The slow death of Twitter: if not there, then where?

#### 120 Steve Cassidy

The annoying habits and out-of-date working practices that have no place in the modern tech world.

BELOW How blue are you? Rois tackles the cuddly toy conundrum

on p116



### → SUBSCRIBE AND RECEIVE A FREE GIFT

Subscribe to PC Pro today and you can benefit from our limited-time offer: see p108 for full details.



### → THE PC PRO PODCAST

Listen live to the PC Pro podcast every Thursday at 1pm. Join us at [pcpro.link/discord](https://pcpro.link/discord)

## REVIEWS THIS MONTH

### LAPTOPS & CONVERTIBLES

- 46 Apple MacBook Pro (M3)
- 58 HP Dragonfly G4
- 60 Lenovo ThinkBook Plus Gen 4
- 63 Dell Inspiron 14 2-in-1 (AMD, 2023)

### DESKTOP PCs

- 52 Apple iMac 24in (2023)
- 55 Cyberpower Infinity X147 GRE Gaming PC

### HANDHELD COMPUTER

- 56 Lenovo Legion Go

### DESKTOP MONITOR

- 65 Mobile Pixels Geminos

### WI-FI MESH

- 68 Amazon Eero Max 7

### SMART GLASSES

- 70 Lenovo Legion Glasses
- 71 Ray-Ban Meta Smart Glasses

### SMART DISPLAY

- 72 Amazon Echo Show 8 (3rd generation)

### PORTABLE MONITOR

- 74 Mobile Pixels Duex Max

### KEYBOARD

- 74 Cherry KC 200 MX

### WEBCAM

- 75 Obsbot Tiny 2

### TABLETS

- 82 Amazon Fire Max 11
- 83 Apple iPad (10th generation)
- 84 Apple iPad Pro 12.9 (6th generation)
- 85 Lenovo Tab P12
- 86 OnePlus Pad
- 87 Samsung Galaxy Tab S9 Ultra
- 88 Apple iPad Air (5th generation)
- 88 Google Pixel Tablet
- 89 Honor Pad 8
- 89 Honor Pad X9
- 90 Lenovo Tab Extreme
- 90 Samsung Galaxy Tab S9
- 91 TCL NXTpaper 11

### VIDEOCONFERENCING SYSTEMS

- 96 Biamp MRB-M-X400-T
- 97 Epos Expand Vision 5 Bundle
- 98 Logitech Rally Bar Huddle
- 99 Owl Labs Owl Bar

### FIREWALL APPLIANCES

- 100 Allied Telesis AT-AR4050S-5G
- 102 Firewalla Gold SE

## LABS



p76

# Luxury TABLETS

Tablets arrived with a bang and then seemed to whimper away, with only the iPad standing strong. But now they're back in a variety of premium guises well suited to creative and productivity tasks.

## Buyer's guide

### 94 Videoconferencing systems

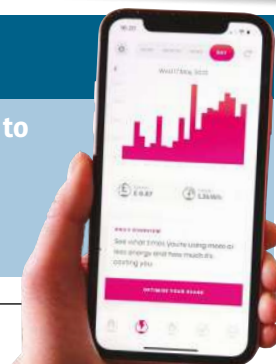
We pick the best videoconferencing kit for knitting on-site and remote teams together, as well as helping meetings with clients.



## Futures

### 126 The British startups helping to combat the cost of living crisis

Nicole Kobie reveals the UK companies building tools to cut energy use, reduce bills and find help for those who need it.



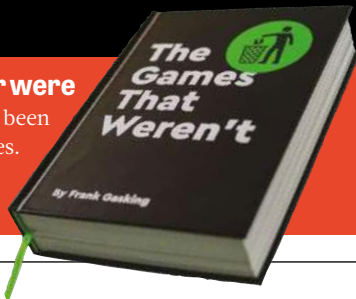
p65

Double your desktop with the innovative Mobile Pixels Geminos

## RETRO

### 123 The games that never were

For 30 years, Frank Gasking has been on the hunt for unreleased games. David Crookes catches up with gaming's digital detective.





Windows 11



GAME PASS

£15 DISCOUNT  
USING CODE  
PRO23



## STUFF YOUR STOCKINGS WITH SAVINGS

Powered by Windows 11.

Now with 1 Month Game Pass Ultimate included. Configure yours at

**[WWW.PCSPECIALIST.CO.UK](http://WWW.PCSPECIALIST.CO.UK)**



PCSPECIALIST



# If technology were a garden it would be bursting with colour

**H**as there ever been a more exciting time in technology than today? Even if you account for recency bias, I don't think so. Not in the 1950s when the first commercial computers appeared, nor the PC revolution in the 1980s. Not even when the world woke up in the early 2000s to realise the internet had bound itself so tightly to the economy that Japanese knotweed clapped in admiration.

Although it's hard to avoid artificial intelligence, that isn't the only technology in town. Quantum computing is starting to sprout – if you will allow me to continue my garden analogy – and by this time next year I expect the first blooms to appear.

Then we have augmented reality. Following on from the Meta Quest 3 in the last issue, this month we were impressed by Lenovo's Legion Glasses (see p70). Come 2024, we will see not only Apple's Vision Pro go on sale but also, I suspect, a bunch of AR offerings from all the big manufacturers.

Nor is there any sign of innovation stopping. Anyone who is of the mind that "everything that can be invented

as has been invented" (which sadly Charles Duell, commissioner of the US patent office at the turn of the 20th century, never actually said) need only turn to my reviews of the Mobile Pixel Geminis (see p65) and Duex Max (see p74) displays. If even monitors aren't safe from change, what is?

I'm also struck by tech CEOs' level of fame. A week rarely passes when Elon Musk isn't in the headlines – including at the recent Bletchley Park AI summit (see p12) – while Sam Altman surely became a household name the moment the OpenAI board tried to oust him. Alongside sportspeople and actors, tech pioneers have joined the celebrity elite.

If I were to put on my optimistic hat, I'd say there's even a chance that technology will solve some of the world's biggest problems in the next few years. Nicole reveals the British startups aiming to mitigate the cost of living crisis from p126, we can find vaccines faster than ever thanks to hybrid quantum computing, and if Elon is to be believed we'll all be living our best, high-income lives because AI will do the heavy lifting. Although, to

be frank, that last scenario is one of my worst nightmares.

Aside from the prospect of AI turning the human race into a subservient species, there is a more immediate dark side to technology. Cyberattacks are more convincing and more targeted than ever thanks to generative AI, and we dedicate seven pages of this magazine to keeping safe in 2024: four aimed at end users (see p34), three at businesses (p104). If you think you don't need to read them, allow me to reveal that one of our contributors had thousands of pounds drained from his account after an attack recently. Attackers are getting more sophisticated, so we must, too.

But that's the thing about technology. Like all cutting-edge developments it comes with danger. Digital Venus flytraps, if you will, ready to gobble any unsuspecting passers-by. So, my excitement is tempered by caution – but not enough to make me look forward to 2024 with anything but eagerness.

**Tim Danton**  
Editor-in-chief

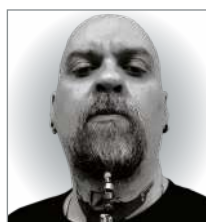
## CONTRIBUTORS



**Nik Rawlinson**  
Can it really be possible to use a Raspberry Pi 5 as your main desktop computer? Not only does Nik believe the answer is yes, but he shows you how, too. See p38



**Darien Graham-Smith**  
Boot Camp may be history on Apple silicon Macs, but there are still ways to run Windows applications on a Mac. Darien walks you through your options from p42



**Davey Winder**  
Along with his regular column from p118, where Davey puts the boot into Threads and cars stealing your data, our security guru explains how to protect your business in 2024 from p104



**Rois Ni Thuama**  
After sitting next to a CEO who claimed his company had built a quantum computer, Rois has one simple message: beware of companies making big claims, as they could leave you out of pocket. See p116

## EDITORIAL

EDITOR-IN-CHIEF

Tim Danton editor@pcpro.co.uk

EDITORIAL FELLOW

Dick Pountain

ASSOCIATE EDITOR

Darien Graham-Smith

FEATURES EDITOR

Barry Collins

FUTURES EDITOR

Nicole Kobie

NEWS WRITER

James O'Malley

BONUS SOFTWARE EDITOR

Nik Rawlinson

## ART & PRODUCTION

ART DIRECTOR

Paul Duggan

FREELANCE DESIGN

Bill Bagnall

PRODUCTION EDITOR

Steve Haines

## CONTRIBUTING EDITORS

Steve Cassidy

Lee Grant

Dave Mitchell

Jon Honeyball

Rois Ni Thuama

Olivia Whitcroft

Davey Winder

## CONTRIBUTORS

Stuart Andrews

David Crookes

Hamish Hector

Allisa James

Tony Polanco

Michelle Rae Uy

Lance Ulanoff

Alex Wawro

## ADVERTISING

GROUP ADVERTISING MANAGER

Ben Topp: ben.topp@futurenet.com

ADVERTISING MANAGER

Alexandra Thomas:

alexandra.thomas@futurenet.com

## PRODUCTION

SENIOR PRODUCTION MANAGER

Lawrence Brookes

## CIRCULATION & SUBSCRIPTIONS

CIRCULATION MANAGER

Emma Read

SENIOR CAMPAIGN MANAGER

Juber Ahmed

DIRECT MARKETING EXECUTIVE

Lewis Smythe

## LOGOS & REPRINTS

ENDORSEMENT LICENSING MANAGER

Ryan Chambers:

ryan.chambers@futurenet.com

We predict 2024's biggest security threats on p34 (for consumers) and p104 (for businesses), and this month we asked our contributors if they could predict one amazing, terrible or startling thing that might happen next year...

"This is a risky prediction, but I think that by the end of 2024 we will all have something resembling our own personal AI. Something we turn to on a daily basis. Where it lives – phone, PC, cloud – I'm not so sure."

"I think 2024 could actually be the year of Windows on ARM... for real this time."

"One of the major messaging apps will withdraw from the UK as a consequence of the Online Safety Act, prompting others to follow."

"Tim Cook will give 12 months' notice of his retirement. He'll turn 64 on 1 November next year, and he's had a great run at Apple since taking over in 2011. Why not go out on a high?"

"2024 will be when much of the 3G network gets turned off. It's been planned for years, infrastructure nerds love it – but millions of people who 'just have a phone' are going to wake up one morning to a brick."

"I predict that Microsoft is going to roll back on sending Windows 10 to the gallows and give it a reprieve. I also think that a major phone brand will announce a handset with a removable battery. Finally, Barry's next beach shoot will shatter all known subscription records on OnlyFans."

"Wherever you look in the world next year, big elections are on the cards. So I predict election fraud like we've never seen before, with plenty of deepfake AI-generated videos."

"Amazing: Apple ecosystem expansion. Terrible: Android ecosystem fragmentation. Startling: generative AI stagnation."

PC  
PRO

LETTERS letters@pcpro.co.uk

TWITTER @pcpro

FACEBOOK facebook.com/pcpro

SUBSCRIPTION ENQUIRIES 0330 333 9493

customer@subscribe.pcpro.co.uk

or visit mymagazine.co.uk

## PRODUCTION & DISTRIBUTION

Printed by Walstead Roche.

Distributed by Marketforce (UK) Ltd, 2nd Floor,  
5 Churchill Place, Canary Wharf, London, E14 5HU.  
Tel: 020 3787 9101.

PC Pro is produced by Danton Media Limited and published monthly by Future plc.

## COPYRIGHT

© Future plc 2023. PC Pro is a registered trademark. Neither the whole of this publication nor any part of it may be reproduced, stored in a retrieval system or transmitted in any form or by any means without the written permission of the publishers.

## SUBSCRIPTIONS

Price: UK £62.99; Europe £70; Rest of World £90. Visit subscribe.pcpro.co.uk/offer for our best offers. To renew a subscription, change an address or report any problems, please visit mymagazine.co.uk.

Please note: Distribution remains disrupted within UK and international delivery networks. Please allow up to seven days before contacting us about a late delivery.

## LIABILITY

While every care has been taken in the preparation of this magazine, the publishers cannot be held responsible for the accuracy of the information herein, or any consequence arising from it. Please note that all judgements have been made in the context of equipment available to PC Pro at time of review, and that "value for money" comments are based on UK prices at the time of review, which are subject to fluctuation and are only applicable to the UK market.

## SYNDICATION & INTERNATIONAL LICENSING

PC Pro is available for licensing overseas. Contact Phoebe Griffin-Beale, phoebe.castledine@futurenet.com



## CERTIFIED DISTRIBUTION

18,977 (Jan-Dec 2022)

FUTURE

Connectors.  
Creators.  
Experience  
Makers.

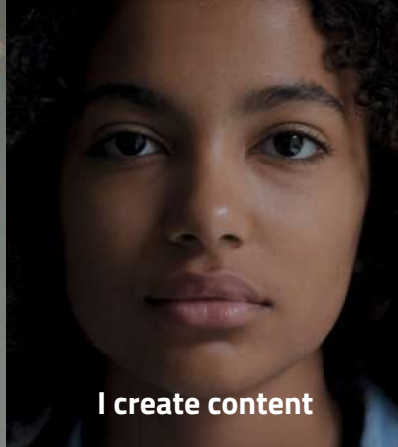
Future plc is a public company quoted on the London Stock Exchange (symbol: FUTR)  
www.futureplc.com

Chief Executive Officer Jon Steinberg  
Non-Executive Chairman Richard Huntingford  
Chief Financial and Strategy Officer Penny Ladkin-Brand

Tel +44 (0)1225 442 244



I'm a ux designer



I create content



I'm in finance



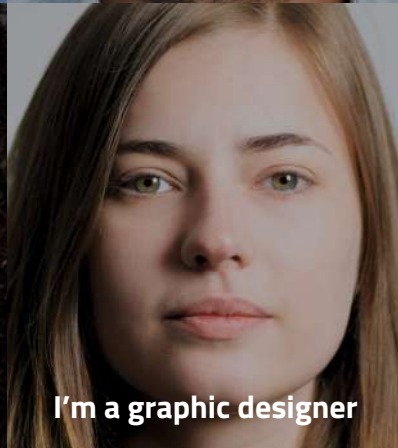
I'm an illustrator



I'm a video editor



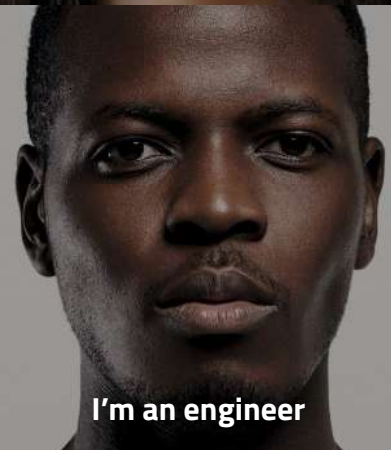
I'm a gamer



I'm a graphic designer



I play esports



I'm an engineer



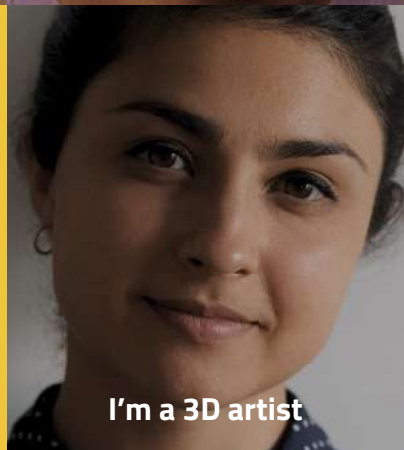
# Chillblast

Game. Create. Win.

**£75 OFF PCs\***  
with code: PCPRO352

\*Minimum spend £1500

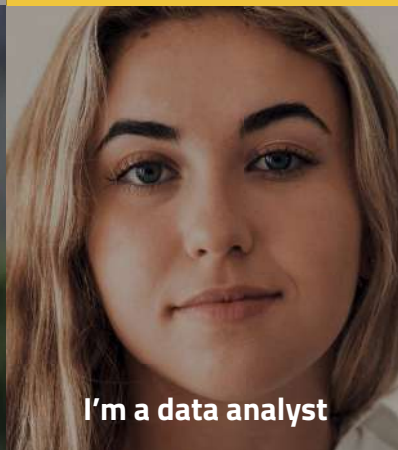
#achieveamazing



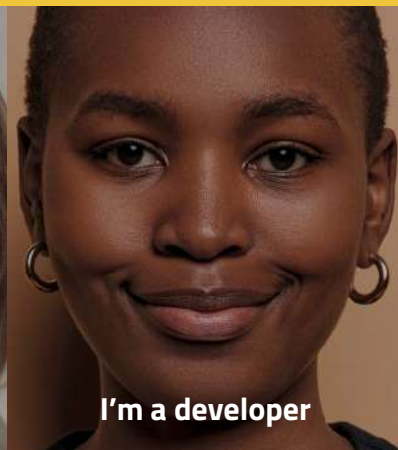
I'm a 3D artist



I'm a marketer



I'm a data analyst



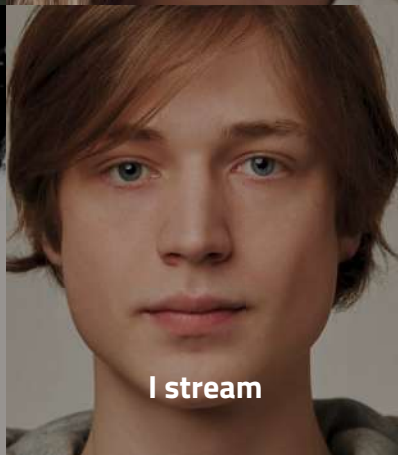
I'm a developer



I'm an architect



I'm a CEO



I stream



I'm a games designer



I'm a scientist

# Briefing

Background and analysis on all the important news stories

## NASA patches probes a solar system away

Space agency provides exceedingly long-distance tech support



**M**aintaining legacy hardware isn't easy when you're in the same office. It's a somewhat greater challenge when you're updating a computer that is literally on the other side of the solar system.

That was the problem facing NASA recently, as the agency was forced to issue a software patch for Voyager 1, an unmanned probe launched in 1977, days after Elvis Presley died. Almost 50 years later, it's just about functional while speeding through space, a mere 15 billion miles away.

As you might expect, the hardware is creaking. Last year, the team noticed a problem with the thrusters that keep the craft's antennas pointed towards Earth. After puzzling over corrupted data, they realised that a build-up of propellant residue was preventing them from firing properly – which, if left untreated, could result in Voyager 1 losing touch with us.

Fortunately, the scientists determined that a software update could fix the problem. Modifying how

often and how much the thrusters fire would mitigate the residue build-up. The bad news was that applying the software update to both Voyager 1 and its deep space companion, Voyager 2 (which also launched in 1977), would be far from a regular Patch Tuesday, according to Bruce Waggoner, an engineer working on the Voyager programme at NASA's Jet Propulsion Laboratory (JPL).

"They were built at JPL and the machine language they use is a JPL-specific version that people cooked up here," said Waggoner. "It looks similar to other 1970s and 80s opcode architectures you see in processors, but it's a unique set of instructions and the software isn't necessarily well written. It was written by people who were just learning the code like everybody was in the 70s and 80s."

Being half a century old, the system is relatively simple compared to modern standards. And this was both a blessing and a curse for the team working on the software.

**ABOVE** Updates to the Voyager space probes have kept them working

"Any time we patch, we're not doing what you envision with the modern computer," said Waggoner. "We're literally just writing over the bits we want to change directly. We're doing a poke command, essentially."

### ■ Poking around

Exactly how the poke command would be issued was a trickier question – one that required NASA to blow the dust off its rolodex. "One of our retired software engineers was pulled back in and worked a lot of overtime and hobby time, and figured out what the issue was," said Waggoner.

Before the code was deployed to the probe, it was extensively vetted on the ground by engineers, but testing was also a challenge. "We used to have

an actual copy of the flight components in hardware and we could run those with model parameters coming in [but] that was retired decades ago," said Waggoner.

**“One of our retired software engineers was pulled back in and worked a lot of overtime”**

However, modern computing did provide one convenience. Thanks to improvements in computational power, the retired engineer could build a software simulator to test the code that was significantly more sophisticated than what NASA had access to historically – meaning the team could properly simulate the space environment.

This proved invaluable, because the fix for the thrusters was surprisingly complex code. It wasn't just changing a specific value in the code, but manipulating how the Attitude and Articulation Control Subsystem

(AACS) behaved.

"The bit of code we were fixing here was actually embedded in some of the timing cycles that run on the AACS computer, and that's what was concerning to us," said Waggoner.

Having tested it thoroughly with the simulator, Waggoner and his team were confident the patch would work successfully when it was applied. That confidence wasn't misplaced: the patch appears to have landed without a hitch, and Voyager is again beaming back data from the furthest reaches of our solar system.

But as Voyager 1 continues to age, we can expect more daring upgrade missions such as this one to keep it alive, as more components fail with age. Already, the camera that took the iconic "Pale Blue Dot" photo has been long out of service. And today, only the more basic scientific instruments continue to function and collect data.

"Every year we have to take more risks," said Waggoner. "Towards the end of the decade, there are some very scary things that we might have to try and so having the simulator is going to be great."

Given how distant the two Voyager probes are, getting a few years more out of both is vital. "It's not clear to me that we will ever have two spacecraft outside the heliopause, outside the sun's magnetic influence, at the latitudes they're at for decades or even centuries," said Waggoner.

Although astronomers have access to powerful telescopes both on Earth and in orbit (in the form of Hubble and the James Webb Telescope), Voyager 1 and 2 both do something these newer devices can't. "The only true data set, the only in situ data that we'll ever have for decades is going to come from these two Voyager spacecraft," said Waggoner. "So, it's really a fantastically important data set Voyager's bringing home that won't be replicated for a long, long time."

**“Towards the end of the decade, there are some very scary things that we might have to try”**

## The smart meter switch-off

3G's decline is bad news for the nation's smart meters

Sending a human to read your electricity or gas meter should already be a thing of the past. The government and utilities companies had hoped to finish the switchover by 2019, but today only 57% of the 57.1 million meters in the country are transmitting readings wirelessly.

Now there's another oncoming obstacle. According to a recent report from Parliament's Public Accounts Committee, 7 million of the smart meters that have already been installed look set to go dark between now and 2030, during which time 2G and 3G are being gradually switched off by the phone networks.

This means that despite being a long way behind the initial target, energy companies are going to have to fix existing installations, too.

"There is an expectation that all technologies will come to an end and obviously current infrastructure would need to be replaced, but you would hope that they will do it gradually over a period of years," said Sam Colley, CEO of Pod Group, an enterprise network operator that specialises in IoT equipment.

The problem is that many smart meters were not built with 5G or even 4G communications modules, because at the time they were installed they were too expensive or simply didn't exist.

But there is some good news. When the utility companies do begin upgrades, there could be cheaper and more

specialist options. "There were newer technologies created that were much more effective in terms of battery consumption, and that also have less requirements on the network from a signalling perspective," said Colley, pointing at the development of two new communication standards, NB-IoT and LTE-M, in the years since the smart meter rollout began in the UK.

Both standards are perfect for smart meters because they're low bandwidth, and both can be obtained at a lower unit cost than traditional cellular chips – meaning the cost of upgrading the communication module on smart meters might not be quite so disastrous.

So what happens next? The Parliamentary committee has done the only thing a committee can do: make a recommendation. It's urging the government to set out a timetable for upgrading the soon-to-be redundant meters, and encourage the energy companies to use only future-proofed tech for the rest of the rollout.

Though it may be annoying and expensive for the energy companies, Colley is optimistic that consumers won't be going back to manual meter readings. "Having been in the US for nearly a decade and having seen this transition already because those 2G, 3G networks have already gone, it really was far less dramatic than you'd think," he said.

Your smart meter may already be on the verge of obsolescence



## What did the Bletchley AI summit actually achieve?

The big names of AI and government were there, but will it make a difference?

**James O'Malley** explores the impact of the first AI Safety Summit

**A**t the start of November, Britain was briefly the centre of the tech world as high-ranking politicians, Silicon Valley luminaries and respected academics all descended on Buckinghamshire for what was billed as the world's first intergovernmental summit on AI safety.

The meeting at Bletchley Park was the brainchild of Prime Minister Rishi Sunak, and was his dual attempt to establish Britain as a major player in the AI revolution and cement himself a political legacy.

On the strength of the guest list, it certainly appeared to be a success. Representing tech was OpenAI founder Sam Altman, X CEO Elon Musk, and Mark Zuckerberg's top lieutenant and former Deputy PM Nick Clegg. The political attendees included US Vice-President Kamala

Harris, EU President Ursula von der Leyen and, most controversially, China's vice-minister of science and technology, Wu Zhaohui.

With so many important people in the same room, the summit surely couldn't fail to deliver meaningful outcomes. Could it?

### ■ The Bletchley Declaration

Experts in the security industry claim the government made a rod for its own back with the way the gathering was billed. "The word 'summit' is a little problematic," said Professor Ciaran Martin, chairman of cybersecurity firm CyberCX UK. "A 'summit' means a bunch of leaders staying up to four in the morning... and these exhausted people producing a document that has legal force."

Alas, nothing quite so dramatic happened at Bletchley. Instead, it was more like an academic conference, a talking shop that concluded with the PM interviewing Elon Musk. That doesn't mean it was a waste of time, however.

"Overall, it was a very, very good thing to do because the alternative was nothing at all," said Martin, who was the founding CEO of the British government's National Cyber Security Centre and head of cybersecurity at GCHQ.

The fact that the summit got nations talking about the threat posed by AI is, in his view, a good thing. "Bureaucracies respond to the need for activity," said Martin.

He said a community has been established that includes the "world's major governments, it's got most of the world's major tech companies, and it's got a bunch of academic experts and so forth who have looked at what the parameters of an outline framework for what regulating AI technologies can be.

"That's actually quite meaningful progress because it means that a process has been established which did not previously exist, which commands pretty broad global confidence and which has a programme of work to take you forward."

Perhaps the most tangible takeaway from the summit is that it established a common basis on which the global community can build future agreements or institutions. This was best

### Musk's AI mind games

The most high-profile moment of the summit didn't take place in Bletchley. Back in London, journalists and tech figures were treated to the unusual sight of the British Prime Minister, Rishi Sunak, interviewing Elon Musk on stage.

During the conversation, though they were both broadly enthusiastic about the potential for AI, Musk warned that AI could be "the most destructive force in history", leading to mass unemployment, and painted an apocalyptic picture of killer robots.

"At least a car can't chase you up a tree, you can go hide indoors... but if you have a humanoid robot it can basically chase you anywhere," Musk said.

So, it was curious timing to say the least that, days after the AI Safety Summit, Musk announced the launch of his own ChatGPT-like large language model, named Grok. Trained on real-time information from X, Musk

promised that Grok "loves sarcasm", the implicit selling point being that it would be less paternalistic and censorious than rivals.

Musk demonstrated its capabilities on his social network, which included asking the AI how to make cocaine, and it complying with an instruction to make a response "more vulgar".

"The guy who's pushing the hardest that it [AI] could end the world literally drops his own LLM, trained on one of the most biased data sources we have, and says it's going to answer the 'spicy' questions," said Keegan McBride. "It doesn't make a lick of sense."





**ABOVE** Attendees pose for the camera at the government's AI summit

demonstrated by an agreement called the Bletchley Declaration, which was signed by 28 attending countries, along with representatives of the European Union, at the end of the first day.

"We affirm that, for the good of all, AI should be designed, developed, deployed, and used, in a manner that is safe, in such a way as to be human-centric, trustworthy and responsible," the statement read, specifically zeroing in on threats posed by sophisticated "frontier" AI systems, and the need for internationally agreed solutions.

But not everyone was convinced. "Yes, it's nice that they have signed the same sheet of paper, I suppose, but will it actually fundamentally lead to any sort of transformation? Almost certainly not," said Keegan McBride, a researcher who specialises in AI and government at the Oxford Internet Institute.

He argues that the summit did not match the high expectations set by the government. "What you've seen in the months leading up to it was just a complete transformation in what the goals and the ambitions of this thing were," he said, describing how when the summit was first announced the ambition was to establish a global AI regulator, with Britain at the centre of global AI safety.

But in the intervening time, it appears that global politics had other ideas. Several governments have already announced AI-regulation plans, including the USA: days before the summit, President Biden signing a declaration that created an US-based AI regulator.

"The UK got undercut in a way by the US with the executive order, [and] by the G7 with the Hiroshima AI Process, which both talk about building AI systems safely," said McBride.

"Then you had the Bletchley Declaration, which is basically saying that AI might do some bad stuff, and we should talk more about it... And that's about it.

"It feels underwhelming in many ways," he added.

However, Martin sees the Bletchley Declaration with the glass half-full. "You can look at it negatively," said Martin. "It's a pretty thin document with some very high-level principles. [Or] you can look at it positively, which is... when was the last time the United States and China signed a meaningful joint position on something to do with technological security?"

## Examining AI models

One of the peculiarities of the AI summit was the willingness of the big tech firms to almost volunteer themselves for regulation. On the second day of the summit, it was announced that companies including Google, Amazon, Meta, Microsoft, OpenAI and X had all agreed to collaborate with government regulators on testing before releasing new "Frontier" AI models publicly, with regulators empowered to test for "national security, safety and societal" risks.

Exactly what such testing would look like was left ambiguous, but much like getting the United States and China to sign up to the same principles, Martin sees similar progress with the tech firms.

Before the summit, there "was no acceptance [of regulation] by the big tech leaders, there was no acceptance that there was any duty to engage with governments," said Martin, pointing to how the past year has seen incredible leaps in the demonstrated capabilities of AI, all without regulators to check the tech firms' work before new models and tools were publicly released.

Bletchley potentially marks the beginning of a new safety regime. "You don't have that gap in the future," said Martin, as now there is a basic framework – and crucially an expectation that regulators will get involved before the next leap forward.

"[The new agreement] accepts that there is such a duty... with details to be filled in as to how it will work," he added.

**“It’s nice that they have signed the same sheet of paper, but will it actually lead to any sort of transformation? Almost certainly not”**

## A victory for Britain?

So did the summit establish Britain an AI power? And was it

a personal success for the Prime Minister? "It was a good week for him, it was a very good event and he deserves a lot of credit for bringing the world together," said Martin.

But there was perhaps something uncomfortable throughout the proceeding: the uncertainty about whether AI represents an opportunity or a threat. It was a dichotomy that McBride noticed in a speech by Sunak himself.

"It just blows my mind," said McBride. "He was like, 'it could even lead to the end of humanity if AI systems escape, [and] terrorists are going to create bioweapons... but don't worry, we're not going to regulate it [too much] because we want to support innovation'."

Maybe such a disconnect was inevitable, though, while everyone involved still tries to figure out what AI is capable of. "It's pretty hard to expect there to be a political consensus around what problems you're prioritising when there isn't yet a scientific, business or technological consensus," said Martin. "I think the politicians knew that in some respects; I think everybody was too polite to say this out loud."

# The A-List



The best products on the market, as picked by our editors

## PREMIUM LAPTOPS

NEW ENTRY

### Apple MacBook Pro 16in (2023)

**M3 power from £1,699**  
from [apple.com/uk](https://apple.com/uk)

The M3 chips give the already brilliant MacBook Pro series a boost in games with no sacrifices elsewhere, so power users who are happy with Apple must grapple with the big decisions: which M3 chip, which size of screen, and how much RAM and storage?

**REVIEW** Issue 352, p46



## BUSINESS LAPTOPS

### Lenovo ThinkPad X1 Carbon Gen 11

**Business class from £1,583 exc VAT**  
from [lenovo.com](https://lenovo.com)

Fight past Lenovo's opaque pricing – another flash sale, really? – and you'll find a slim, powerful and long-lasting laptop for a competitive price. With a wide range of available configurations, all based on Intel's 13th generation Core chips, this is our top choice for all sizes of business.

**REVIEW** Issue 350, p85



## ALTERNATIVES

#### Asus Zenbook S 13 OLED (UX5304)

The perfect 13in laptop? At 1kg, it packs power along with 1TB of storage, a top-quality OLED panel and superb battery life. **£1,600 from** [uk.store.asus.com](https://uk.store.asus.com)

**REVIEW** Issue 348, p58

#### Samsung Galaxy Book3 Ultra

Samsung packs everything into this 16in laptop, from a superb AMOLED panel and a slim 1.8kg chassis to a Core i9 CPU and RTX 4070 graphics. Expensive but top quality. **From £2,449 from** [samsung.com/uk](https://samsung.com/uk)

**REVIEW** Issue 344, p46

#### Apple MacBook Air 15in

It's no MacBook Pro, but with an 8-core M2 chip the 15in MacBook Air offers solid performance and a spacious, good-looking display for a great price. **From £1,399 from** [apple.com/uk](https://apple.com/uk)

**REVIEW** Issue 347, p60

## GAMING LAPTOPS

### Asus ROG Zephyrus M16 (2023)

**Core i9/4090 for £4,100**  
from [rog.asus.com/uk](https://rog.asus.com/uk)

Asus includes everything in this gaming laptop, including a personalisable lid via a matrix of lights. And a 16in AMOLED screen, 2TB SSD and cutting-edge components. If the £4.1K price puts you off, Overclockers UK sells an RTX 4080 version with a plain lid for £3,300.

**REVIEW** Issue 343, p50



## ALTERNATIVES

#### Lenovo Legion 5i Pro (16in)

A great-value gaming laptop that's extracts the most from its powerful components. We love the keyboard, too. **Part code 82RF002LUK, £2,000 from** [lenovo.com/gb](https://lenovo.com/gb)

**REVIEW** Issue 337, p61

#### Asus ROG Strix Scar 18

It's expensive, but if you want an 18in laptop that delivers all-out power this is the no-compromise 3.1kg beast to buy – it packs quality everywhere. **£3,999 from** [scan.co.uk](https://scan.co.uk)

**REVIEW** Issue 344, p54

#### Razer Blade 18

A great advert for 18in gaming laptops, the Blade 18 partners a Core i9-13950HX with RTX 40-series graphics in a stunning, slim design. **From £2,900 from** [razer.com/gb-en](https://razer.com/gb-en)

**REVIEW** Issue 343, p52

## EVERYDAY LAPTOPS

### Honor MagicBook 16 X (2023)

**Full metal jacket for £700**  
from [hihonor.com](https://hihonor.com)

A high-quality all-metal chassis marks the MagicBook 16 X 2023 out from the budget laptop crowd, and it's packed with good-quality (albeit not top-quality) components, from a 12th gen Core i5 chip to a 1,920 x 1,200 16in IPS panel.

**REVIEW** Issue 348, p59



#### Asus Vivobook S 15 OLED

The Core i5 version of this 1.7kg laptop offers amazing quality for under a grand, including a high-quality 15.6in OLED display. **From £949 from** [pcpro.link/347asus2](https://pcpro.link/347asus2)

**REVIEW** Issue 347, p85

#### Microsoft Surface Laptop Go2

The Laptop Go 2 won our recent group test of affordable laptops thanks to its high-quality 12.5in screen, 1.1kg weight and sleek design. **£555 from** [microsoft.co.uk](https://microsoft.co.uk)

**REVIEW** Issue 347, p89

#### MSI Prestige 15

Not the most cultured laptop, but great value considering the connectivity, 15in screen, fast specs and a GeForce RTX 3050 GPU (part code A12UC-034UK). **£849 from** [laptopoutlet.co.uk](https://laptopoutlet.co.uk)

**REVIEW** Issue 347, p93

## CHROMEBOOKS

### Acer Chromebook Plus 515

Double power for £400

from currys.co.uk

An excellent debut for Google's Chromebook Plus initiative, with Intel's Core i3-1315U CPU providing the power, with 8GB of RAM and 256GB of storage for company. The chassis is well built, and the 15.6in screen is good for the price.

**REVIEW** Issue 351, p44



### Acer Chromebook Vero 514

Acer combines its eco-conscious Vero brand with Chrome OS to great effect in this surprisingly powerful 14in Chromebook. With a 12th generation Intel Core i5 processor, 8GB of RAM and a 256GB SSD, plus Chrome OS updates until 2030, it's a fine long-term investment that helps cut down on electronic waste.

**£599 from currys.co.uk**

**REVIEW** Issue 340, p54

### HP Elite Dragonfly Chromebook

This is quite simply the best business Chromebook around, although at the time of writing we're waiting for units to hit the market. Build quality is stunning, as is this 13.5in convertible's 1.3kg weight.

**From £1,000 from hp.co.uk.**

**REVIEW** Issue 337, p86

## EVERYDAY PCs

### Apple Mac mini (2023)

M2 masterpiece from £649

from apple.com/uk

The outside remains the same, but this simple yet effective update to the Mac mini introduces the M2 and M2 Pro processors with predictable effect. The entry-level price quickly rises once you start upgrading – moving from 8GB to 16GB costs £200, as does doubling the base storage from 256GB to 512GB – but there's enough power here to last you for years.

**REVIEW** Issue 343, p60



### Intel NUC Pro 13

If you don't need discrete graphics then Intel's mini PCs are a fantastic choice, being easy to upgrade, low on energy consumption and more than powerful enough to cope with Windows applications – despite being little larger than a coffee coaster.

**Barebones, from £350; full PCs,**

**from £600, from scan.co.uk**

**REVIEW** Issue 345, p48

### PCSpecialist Topaz Supreme

This is an all-AMD system, with a Ryzen 5 7600 partnered with Radeon RX 6600 graphics. That's enough for smooth 1080p gaming, and the Topaz also has 16GB of Corsair DDR5 RAM and a speedy 1TB SSD. At this price, it's simply fantastic value.

**£899 from pcspecialist.co.uk/reviews**

**REVIEW** Issue 347, p54

## ENTHUSIAST PCs

### Chillblast Apex Ryzen 9 RTX 4090 Gaming PC

7950X3D and RTX 4090 for £4,400

from chillblast.com

A brilliant choice if you're looking for easy expansion tomorrow coupled with cutting-edge gaming with high-quality components today.

**REVIEW** Issue 347, p52



### HP OMEN 45L (2023)

We tested the top-end 45L with a Core i9-13900K, GeForce RTX 4090 graphics and 64GB of RAM, and it doesn't come cheap. Switch to the Core i7/RTX 4070 Ti version, however, and the price almost halves without losing any of the superb design and build quality.

**£4,800 from hp.co.uk**

**REVIEW** Issue 347, p50

### Alienware Aurora R16

An understated yet stylish gaming PC that runs quietly even when pushed. This rig has power where it counts, mixing Intel's latest CPUs with Nvidia's RTX GPUs. Choose an RTX 4070 or higher to benefit from the glass side and liquid cooling, which lifts it above rivals.

**From £1,349 from dell.co.uk**

**REVIEW** Issue 349, p54

## ALL-IN-ONE PCs

NEW ENTRY

### HP Envy 34 All-in-One

£2,099 widescreen wonder

from hp.com

Built around a high-quality 34in widescreen – which is perfect for viewing two windows side by side thanks to its 21:9 aspect ratio – this also comes with Nvidia RTX 3060 graphics. We're big fans of the magnetic 16-megapixel camera, too.

**REVIEW** Issue 335, p46



### Dell Inspiron 24 All-in-One

Despite being built to hit a price point, the Inspiron 24 All-in-One manages to look classy, include a good-quality, 1,920 x 1,080 24in panel and have enough power to breeze through a typical day's tasks. It even packs mod cons such as a 720p webcam. Superb value for money.

**From £599 from dell.co.uk**

**REVIEW** Issue 350, p47

### Apple iMac 24in (M3)

The iconic design remains the same, but the plain M3 chip inside the revamped iMac 24in is a revelation compared to the previous M1 version. The downside is that the base configuration includes a stingy 8GB of memory and a 256GB SSD.

**From £1,399 from apple.com/uk**

**REVIEW** Issue 352, p52

## CREATIVE WORKSTATIONS

### Scan 3XS GWP-ME A164T

Threadripper Pro for £8,333 exc VAT

from scan.co.uk

Scan matches the 32-core Ryzen Threadripper Pro 5975WX with 128GB of ECC RAM and RTX A6000 graphics to create a stormingly fast all-rounder. As expected, it's finished in a top chassis (the Fractal Design Meshify 2 XL) with Scan's usual attention to detail for build quality.

**REVIEW** Issue 348, p87



### Armari Magnetar MC16R7

A strikingly fast workstation for the money, with Armari's customised liquid cooling extracting the most from an AMD Ryzen 9 7950X. With 64GB of DDR5 RAM and AMD's Radeon Pro W7800 in support, this is a fantastic value machine.

**£3,758 exc VAT from armari.com**

**REVIEW** Issue 348, p84

### PCSpecialist Onyx Pro

Even in a creative workstation, it makes a lot of sense to include Nvidia's consumer graphics due to its core-per-buck. Here, an Nvidia RTX 4090 partners with a Core i9-13900K and an incredible 192GB of RAM to tremendous effect.

**£3,750 exc VAT from pcspecialist.co.uk/reviews**

**REVIEW** Issue 348, p86



## TABLETS

NEW ENTRY

NEW ENTRY

NEW ENTRY

### Apple iPad Pro 12.9in

Simply the best, from £1,249

from [apple.com/uk](https://apple.com/uk)

The best tablet out there thanks to Apple's powerful M2 chip, even if the upgrade prices sting in their usual fashion. In return you'll get a workhorse during the day (especially with the optional Magic Keyboard) and a brilliant entertainer at night.

**REVIEW** Issue 352, p84



### Samsung Galaxy Tab S9 Ultra

The best of the big-screen Android tablets, with the bonus of Samsung's DeX environment if you want to use it as a desktop replacement, while One UI lets you manage multiple windows and multitask between them. The 14.6in AMOLED screen is superb, too.

**From** £1,199 from [samsung.com](https://samsung.com)

**REVIEW** Issue 352, p87

### OnePlus Pad

The OnePlus fully justified its place in our luxury tablet Labs thanks to its outstanding build quality, slick performance and stunning 17-hour battery life. It's the best Android option outside of Samsung's Galaxy Tabs – and it won't do nearly so much damage to your wallet.

**£449** from [oneplus.com](https://oneplus.com)

**REVIEW** Issue 352, p86

## EVERYDAY PHONES

### Motorola Moto G13

Amazing quality for £150

from [johnlewis.com](https://johnlewis.com)

If you only have £150 to spend on a phone then this is a simply brilliant choice. The camera produces superb results, the design is first class, and while it isn't the fastest performer it's fast enough – and the battery life is great.

**REVIEW** Issue 346, p73



### Google Pixel 7a

A phone that begs the question: why spend £150 more for the Pixel 7? With few compromises on the Pixel 7 – it uses the same processor and cameras and the only notable change is a smaller screen – this is the new mainstream pick for Google phone fans.

**128GB, £449** from [store.google.com](https://store.google.com)

**REVIEW** Issue 346, p68

### Motorola Edge 30 Neo

This stylish and compact smartphone – reflected by a small-ish 4,200mAh battery – includes a gorgeous 6.3in OLED screen, nippy Snapdragon processor and a decent pair of cameras for a great price.

**£300** from [motorola.co.uk](https://motorola.co.uk)

**REVIEW** Issue 348, p73

## PREMIUM PHONES

### Google Pixel 8 Pro

Big-screen wonder from £999

from [store.google.com](https://store.google.com)

A starting price of £999 is high compared to its predecessors, but we can't complain about the stunning camera setup or the all-round quality. It's a great showcase for AI in our phones, and seven years of Android updates only adds to its appeal.

**REVIEW** Issue 351, p70



### Google Pixel 8

It's not a huge step up from the Pixel 7, but the added AI features are genuinely useful and it benefits from a handful of upgrades, too – including a 120Hz screen and the new Tensor G3 processor. If you don't mind the lack of optical zoom, it's a great buy for the price.

**128GB, £699**

from [store.google.com](https://store.google.com)

**REVIEW** Issue 351, p72

### Samsung Galaxy Z Flip5

While the Galaxy Z Fold5 has its undoubted attractions, the Flip5 pips it onto this A List slot thanks to it being £700 cheaper and through the usefulness of the expanded front display. It's also IP68 rated and packs a stellar chip, beating rival flip phones.

**From** £1,049 from [samsung.com/uk](https://samsung.com/uk)

**REVIEW** Issue 349, p70

## EVERYDAY MONITORS

### Lenovo ThinkVision P27u-20

4K Thunderbolt, £550

from [lenovo.com](https://lenovo.com)

We reviewed this when it cost £470, but even at £550 it's a superb buy. It's a top-quality 27in panel with a 4K resolution, and it packs superb connectivity, including Thunderbolt 4.

**REVIEW** Issue 344, p89



### AOC Q27P3CW

If you can't afford the ThinkVision P27u-20 then this 27in USB-C docking monitor, complete with solid image quality and a 1440p resolution, offers unmatched value at a shade over £300. It even includes a webcam that supports Windows Hello.

**£310** from [box.co.uk](https://box.co.uk)

**REVIEW** Issue 344, p83

### Iiyama ProLite XCB3494WQSN

Curved 34in monitors proved a popular choice in our Labs, and although it had tough competition from the HP E34m G4 this Iiyama steals a spot on our A List due to Iiyama's twin focus on value and quality panels. There's even gaming potential.

**£400** from [scan.co.uk](https://scan.co.uk)

**REVIEW** Issue 344, p88

## PROFESSIONAL MONITORS

### Eizo ColorEdge CG319X

Creative masterclass, £3,960

from [wexphotovideo.com](https://wexphotovideo.com)

As the price indicates, this monitor is for heavyweight creatives who demand the best in every discipline: HDR video editing, print layouts, professional photography and more besides. With superb coverage and accuracy across all spaces, plus a built-in calibrator, it justifies the investment.

**REVIEW** Issue 327, p81



### BenQ PD2725U

By no means a cheap 4K 27in monitor – unless you compare it to the Eizos – but it marries all-round quality with ease of use thanks to a puck that allows you to quickly move between settings. You can even daisy chain a second Thunderbolt 3 monitor for a monster setup.

**£859** from [photospecialist.co.uk](https://photospecialist.co.uk)

**REVIEW** Issue 327, p80

### Eizo ColorEdge CG279X

Designers who need to work across different disciplines will love how easy it is to switch between the Adobe RGB, DCI-P3 and sRGB colour spaces using the Eizo's fantastic OSD. It's certainly not cheap for a 27in 1440p monitor, but it's packed with quality.

**£1,726** from [wexphotovideo.com](https://wexphotovideo.com)

**REVIEW** Issue 327, p84

## WEBCAMS

NEW ENTRY

### Epos Expand Vision 1

**Top-quality 4K video from £142**  
from [uk.insight.com](http://uk.insight.com)

Videoconferencing expert Epos claims the top spot with its first personal webcam. It delivers on all fronts: audio quality, colour accuracy and low-light performance, and all while undercutting the 4K Logitech opposition by £100.

**REVIEW** Issue 340, p74



### Aukey PC-W3 1080p Webcam

If the thought of spending £142 on a webcam has you spluttering into your microphone then you should consider this far cheaper but high-quality alternative. Its colours are low-key in comparison to the best, but it still produces a sharp and detailed image. **£13 from [ebay.co.uk](http://ebay.co.uk)**

**REVIEW** Issue 321, p72

### Obsbot Tiny 2

This portable 4K webcam delivers for quality, design and sharpness, and it comes with a shedload of advanced features, including dynamic zoom and subject tracking. The only real downside is that it has a price that reflects its premium ambitions.

**£329 from [amazon.co.uk](http://amazon.co.uk)**

**REVIEW** Issue 352, p75

## HOME OFFICE PRINTERS

### HP OfficeJet Pro 9010e

**Fast inkjet for £149**  
from [printerland.co.uk](http://printerland.co.uk)

This is a superb multifunction printer for home offices or very small businesses. It hit almost 19 pages per minute for black text but still produced excellent quality, then backs it up with a great set of features – including an ADF. Even running costs are competitive.

**REVIEW** Issue 341, p81



### Epson EcoTank ET-4850

Twice as expensive as the HP OfficeJet Pro 9010e, and there's no ADF, but the EcoTank wins for running costs: that price includes enough ink to print 5,200 black or 14,000 colour pages. Photos look great on glossy paper, and scans are superb. A great buy. **£335 from [printerland.co.uk](http://printerland.co.uk)**

**REVIEW** Issue 341, p80

### HP Smart Tank 5105

HP makes a late entrance to the bottle-fed party, but this an affordable all-in-one that delivers high-quality mono prints at around 10ppm. And it comes with enough ink for 6,000 pages. Photos aren't a strength, and you don't get duplex printing, but it's superb value. **£170 from [hp.com](http://hp.com)**

**REVIEW** Issue 346, p64

## WORKGROUP PRINTERS

### Canon Maxify GX6550

**Ink tank all-in-one for £392 exc VAT**  
from [canon.co.uk](http://canon.co.uk)

Designed to fit in tight spaces, this all-in-one includes a highly effective ADF and backs it up with high-quality prints at 24ipm in our tests. Running costs are superb, too.

**REVIEW** Issue 350, p58



### Brother X-Series MFC-J6957DW

Ideally suited to SMBs on a tight budget, this affordable large-format inkjet delivers low running costs, good output quality and the best cloud and mobile support around, as well as an A3 scanner with 50-page ADF. **£471 exc VAT from [printerbase.co.uk](http://printerbase.co.uk)**

**REVIEW** Issue 337, p98

### Xerox B315DN

A fine alternative to the Brother and Canon, this mono laser multifunction printer produces superb results at great speed – 27.5 pages per minute in our 50-page test, which includes the spool time. It's similarly quick for scans, with a dual-CIS ADF to speed up double-sided copies. **£238 exc VAT from [printerbase.co.uk](http://printerbase.co.uk)**

**REVIEW** Issue 341, p87

## WIRELESS ROUTERS

### Netgear Nighthawk RAXE300

**Fast Wi-Fi 6E router, £350**  
from [amazon.co.uk](http://amazon.co.uk)

The RAXE500 (see right) is faster than the RAXE300, but in practice we doubt you would notice – this tri-band router still delivered speeds between 50MB/sec and 150MB/sec in our tests. And it's packed with features, too. At £150 cheaper than its bigger brother, we think it hits the Wi-Fi 6E sweet spot.

**REVIEW** Issue 341, p68



### Netgear Nighthawk RAXE500

If you want the fastest Wi-Fi then 6E is the obvious choice, and this router delivers. The Armor protection service costs £38 in the first year, but then rockets up to £85, so you're buying top quality and performance, but you pay for it. **£448 from [box.co.uk](http://box.co.uk)**

**REVIEW** Issue 332, p64

### Asus RT-AX59U

You can buy cheaper Wi-Fi 6 routers – such as the D-Link Eagle Pro AI R15 for £55 – but Asus' well-priced offering delivers strong performance along with lots of control and exceptional VPN support. **£125 from [uk.store.asus.com](http://uk.store.asus.com)**

**REVIEW** Issue 350, p57

## MESH WI-FI

### TP-Link Deco XE200

**Clever Wi-Fi 6E for £600**  
from [amazon.co.uk](http://amazon.co.uk)

There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack (code BOBKTDPC8) should be enough for most premises.

**REVIEW** Issue 349, p65



### Mercusys Halo H80X

A new subsidiary of TP-Link, Mercusys offers its parent brand's XE75 router some excellent value-for-money competition. Not as fast due to Wi-Fi 6 rather than Wi-Fi 6E, but it has all the bandwidth you need for everyday use and should deliver it stably throughout your house. There are plenty of features too. **2-pack, £161 from [ebuyer.com](http://ebuyer.com)**

**REVIEW** Issue 341, p71

### Linksys Velop Pro 6E

Ironically, this Wi-Fi 6E router will get the most out of your non-Wi-Fi 6 devices thanks to its use of the 6GHz network for station-to-station traffic. And you only need two units for rock solid performance across a three-bedroom house. **2-pack, £380 from [amazon.co.uk](http://amazon.co.uk)**

**REVIEW** Issue 350, p54



## BUSINESS WI-FI

### TP-Link Omada EAP690E HD Wi-Fi 6E access point, £515 exc VAT

from broadbandbuyer.com

The Omada has what it takes to satisfy businesses planning on serving up high-density wireless networks. This AXE11000 AP delivers impeccable wireless performance and plenty of enterprise-class features. **REVIEW** Issue 347, p103



### Netgear WAX630E

The tri-band WAX630E – a Wi-Fi 6E access point – delivers strong performance across the 5GHz and 6GHz bands. Netgear's Insight cloud service provides classy remote management and it can't be beaten for value. **£275 exc VAT from broadbandbuyer.com** **REVIEW** Issue 341, p95

### Zyxel WAX630S

Not the cheapest Wi-Fi 6 AP, but the Zyxel WAX630S delivers a lot of features for the price. Performance is impeccable, it can be easily cloud-managed and the CNP+ threat prevention service could save you the cost of a firewall. **£369 exc VAT from broadbandbuyer.com** **REVIEW** Issue 340, p101

## NAS SERVERS

### Synology DiskStation DS1823xs+

10GbE NAS, £1,413 exc VAT

from broadbandbuyer.com

This powerful eight-bay NAS is a great choice for SMBs that want plenty of capacity, features and performance at a reasonable price. The new DSM 7.2 software has security high on its agenda, and the icing on the cake is Synology's generous five-year warranty. **REVIEW** Issue 346, p101



### Qnap TS-h987XU-RP

The TS-h987XU-RP is a ready-made hybrid storage solution for SMBs. This rack-friendly package offers a great specification for the price, and Qnap's QuTS hero software scores highly for its wealth of data-protection features and business apps. **Diskless, £3,292 exc VAT from broadbandbuyer.com** **REVIEW** Issue 344, p96

### Synology DiskStation DS1522+

Small businesses that want a high-capacity desktop NAS at a good price will find Synology's DS1522+ a great choice. Performance over 10GbE is impeccable and the DSM software offers a fantastic range of storage features. **5-bay NAS, diskless £586 exc VAT from broadbandbuyer.com** **REVIEW** Issue 344, p98

## VIDEOCONFERENCING

NEW ENTRY

NEW ENTRY

NEW ENTRY

### Owl Labs Owl Bar

Meeting room buzz factor, £1,999 exc VAT

from owllabs.co.uk

As a standalone VC room solution the Owl Bar has plenty to offer, with good video quality and super-smooth speaker tracking. It really comes into its own when paired with an Owl 3, though, as this unleashes a completely new dimension to your meetings. **REVIEW** Issue 352, p99



### Biamp MRB-M-X400-T

A great choice for businesses that want to transform their meeting room into a professional conferencing space. All the components are surprisingly easy to deploy, Biamp's Launch feature provides slick automated room configuration and the Vidi camera delivers great video quality. **Kit and Vidi 250, £7,718 exc VAT (RRP) from midwich.com** **REVIEW** Issue 352, p96

### Epos Expand Vision 5 Bundle

Perfect for SMBs seeking an affordable Microsoft Teams Rooms solution with seamless BYOD support. Video and audio quality is good, speaker tracking is smooth and the Control tablet makes meeting room management a breeze. **£1,915 exc VAT from misco.co.uk** **REVIEW** Issue 352, p97

## SCANNERS

### Xerox D70n Scanner

Fast and furious, £765 exc VAT

from ballicom.co.uk

The D70n delivers a mighty scan speed together with a wealth of scan management tools and apps. Businesses that want a high-volume networked desktop scanner at an affordable price should put the Xerox at the top of their list. **REVIEW** Issue 346, p99



### Brother ADS-4700W

A fine choice for small businesses, with an impressive range of scanning features at a price that can't be faulted. Output quality is top notch and the versatile LCD touchscreen menus provide great walk-up scan services. **£355 exc VAT from printerbase.co.uk** **REVIEW** Issue 346, p96

### Epson WorkForce ES-C380W

An affordable choice for offices short on space. It delivers on its 30ppm speed promises, Epson's ScanSmart software offers plenty of management features, and its standalone mode makes it very accommodating. **£280 exc VAT from ballicom.co.uk** **REVIEW** Issue 351, p101

## SERVERS

### Dell EMC PowerEdge T350

Xeon E-2300 power, from £1,399 exc VAT

from dell.co.uk

Perfect for SMBs and branch offices looking for an affordable and powerful single-socket tower server. Along with support for Xeon E-2300 CPUs and lots of memory, it has a high storage capacity, plenty of expansion space and is sturdily built. **REVIEW** Issue 335, p98



### Dell EMC PowerEdge R250

With prices starting at around £850 exc VAT for a Pentium Gold CPU, and the option of Xeon E-2300 series chips from £1,461 exc VAT, this is a slim, rack-mounted alternative to the more high-powered T350 that's ideal for SMBs. **From £845 exc VAT from dell.co.uk** **REVIEW** Issue 332, p98

### Broadberry CyberServe Xeon E-RS100-E10

This represents a powerful hardware package at a price that will please small businesses. We love its low-profile chassis and the fine selection of remote-management tools. It's a great alternative to the Dell EMC servers also listed here. **£983 exc VAT from broadberry.co.uk** **REVIEW** Issue 318, p96

## SECURITY SOFTWARE

### G Data Total Security

A suite for power users with a host of useful features that offers formidable protection against viruses. **5 devices, \$82 per year (first year and renewals) from gdatasoftware.co.uk**  
**REVIEW** Issue 343, p83



### Avast One Essential

The only product in our tests to score a 100% protection rating for blocking all malicious files, this reliable choice is our pick of the free AV tools available and includes a free if limited VPN service. **Free from avast.com**  
**REVIEW** Issue 343, p82

### McAfee+ Advanced

A high-end choice with high-end features and support for an unlimited number of devices. Good value for the first year, but watch out for renewals. **Unlimited devices, £75 first year, £150 renewals from mcafee.com/en-gb**  
**REVIEW** Issue 343, p84

## VPNs

### NordVPN

NordVPN won our VPN Labs for the second time running thanks to its consistent, fast speeds, great security features and excellent support for video streaming. **£80 for two years from nordvpn.com**  
**REVIEW** Issue 349, p86



### ProtonVPN

The best free VPN service available, with quick speeds and unlimited bandwidth. The paid-for service isn't cheap, but offers a bunch of useful extra features that might just tempt you into coughing up. **Free from protonvpn.com**  
**REVIEW** Issue 349, p88

### Surfshark

The fastest VPN we've tested, and it's generally a good performer in our region-shifted streaming tests, too. Cancellation is trickier than it should be, but it's a great-value choice for heavy VPN users. **£56 for two years from surfshark.com**  
**REVIEW** Issue 349, p89

## PASSWORD MANAGERS

### NordPass

This hassle-free option is a great choice for both personal and business use, with a competitive price matched with all the features most people need. **£1.89 per month from nordpass.com**  
**REVIEW** Issue 350, p70



### Bitwarden

Free for individual use and open source, the only important thing Bitwarden lacks is phone support: it works with virtually every device and browser, and the paid option is well worth £10 per year. **Free from bitwarden.com**  
**REVIEW** Issue 350, p71

### Keeper

A great choice for businesses thanks to its focus on security and a zero-knowledge policy, and if you need more options then Keeper has them. **Business edition, from £2 per user per month from keepersecurity.com**  
**REVIEW** Issue 350, p72

## ENDPOINT PROTECTION

### Sophos Intercept X Advanced

Delivers a huge range of endpoint protection measures for the price. It's simple to deploy, device and user policies add flexibility, and seamless integration with the Sophos Central cloud portal makes management simple. **500-999 users, 1 year, £36.50 each exc VAT from enterpriseav.co.uk**  
**REVIEW** Issue 351, p98



## BUSINESS BACKUP

### Veritas Backup Exec 22.2

Our top pick for on-premises data protection, Veritas Backup Exec 22.2 offers a superb range of features, great value and backs this all up with swift deployment and an easy-to-use interface. **Simple Core Pack, 5 instances, £389 per year exc VAT from uk.insight.com**  
**REVIEW** Issue 350, p97



## VOIP SERVICES

### 3CX

SMEs worried about the cost and complexity of hosting an IP PBX will love 3CX's free offering. It's easy to use and provides all the call-handling services you need. **Free for 1-10 users from 3cx.com**  
**REVIEW** Issue 345, p96



### WithSecure Elements EPP and EDR

High levels of automation make WithSecure a great choice for SMBs that want endpoint protection on a plate. It's simple to deploy, offers a wealth of security features and is easily managed from the cloud. **100-499 devices, £37 each per year exc VAT from withsecure.com**  
**REVIEW** Issue 351, p99

### IDrive Business

SMBs that want affordable cloud backup and data recovery features will appreciate IDrive Business, with its extensive app and platform support. **2.5TB, £479 exc VAT per year from idrive.com**  
**REVIEW** Issue 347, p99

### Gradwell Wave

Ideal for SMEs that want the smoothest possible path to VoIP, this cloud-hosted service is easy to manage and packed with features. **Wave 100, from £7.50 exc VAT per user per month from gradwell.com**  
**REVIEW** Issue 345, p98

## NETWORK MONITORING

### Progress WhatsUp Gold 2022

Easy to deploy, and with flexible device-based licensing plans, WhatsUp Gold is an affordable choice for SMBs. It presents an impressive set of network-monitoring tools in a well-designed console and tight integration with the LoadMaster and Flowmon apps. **50 devices, Premium, yearly licence, £1,309 exc VAT from whatsupgold.com**  
**REVIEW** Issue 342, p90



## REMOTE SUPPORT

### IDrive RemotePC Team

IDrive's RemotePC Team will appeal to SMBs that want affordable cloud-hosted remote support for their offices and home workers. It's exceedingly simple to deploy, easy to manage and delivers tough access security measures. **First year, 50 computers, £172 exc VAT from remotepc.com**  
**REVIEW** Issue 349, p98



## UTM APPLIANCES

### WatchGuard Firebox T45-W-PoE

Offering enterprise-class gateway security measures at an affordable price, this is a great choice for small to medium-sized business and remote offices. Integral Wi-Fi 6 services add extra value and it can be easily managed and monitored from WatchGuard's slick cloud portal. **Appliance with 3yr Total Security Suite, £3,148 exc VAT from guardsite.co.uk**  
**REVIEW** Issue 348, p98



### Paessler PRTG Network Monitor 22.4

The ability to assign sensors to any device brings versatility, and everything is included in the price so there's no need for optional modules. **1,000 sensors, 1yr maintenance, £2,499 exc VAT from paessler.com**  
**REVIEW** Issue 342, p89

### NetSupport Manager 14

Delivers a wealth of support tools, including secure access to home workers, and licensing plans are good value. **1-500 systems, perpetual licence, £10 each exc VAT from netsupportmanager.com**  
**REVIEW** Issue 349, p100

### Zyxel ZyWALL ATP500

This desktop appliance gives sophisticated protection against zero-day threats, is easily managed and very good value. **Appliance with 1yr Gold Security licence, £1,191 exc VAT from broadbandbuyer.com**  
**REVIEW** Issue 348, p99



# My other computer is an Android



Dick Pountain is editorial fellow of *PC Pro* and sometimes feels his own internal memory is down to 30MB. Email [dick@dickpountain.co.uk](mailto:dick@dickpountain.co.uk)

Ignore the naysayers: there are compelling arguments for Android becoming a huge hit on laptops and PCs just as much as on phones

I had a vague intuition that Android might become the number one operating system in the world – simply because of its ubiquity on smartphones – but I wasn't prepared for the actual market share figures from [gs.statcounter.com](https://gs.statcounter.com). In October 2023, Android devices accounted for 37% of the OS market, Windows 31%, iOS 17%, macOS 9%, ChromeOS 1.9% and "unknown" (much of which will be desktop Linux) 1.8%.

This being so, I wasn't surprised to read last week that Lenovo is teaming up with Android specialist Esper to revamp its ThinkCentre M70 line into an all-in-one desktop Android PC, using Intel Core processors all the way from entry-level i3 models up to heavyweight Core i9s.

I've made no secret in this column that nowadays I use a Chromebook rather than a Windows PC, but what I haven't emphasised is that in effect it's an Android laptop. ChromeOS offers a pleasant enough basic cloud file system, but ChromeOS apps are largely rubbish and its Web Store is a joke. Apart from Google Docs, in which I'm writing this, everything I do is accomplished via Android apps. Strictly speaking, Android runs *inside* ChromeOS *on top of* Linux, but I rarely go there, so let's not.

It all works remarkably well, and the common fallacy that there aren't any grown-up Android apps is simply not true (although I'll admit it's taken me a while to find them). Along with Docs, I now have an excellent photo editor, draw/paint apps, MIDI editor and digital audio workstation (DAW) that serve very well in place of Office, Photoshop and Ableton. Freedom

from Windows upgrades and malware horrors is delightful, and backup ceases to be a nightmare, except...

Except, I'm so paranoid by temperament that although everything is kept "safely" in Google's cloud, I want it local, too. Hence I keep a tiny 128GB USB stickette permanently occupying one port and write all my data – not apps – to that. (A couple of times a year I also copy this stick to a separate hard drive for archival.) Google wouldn't approve, but it keeps me happy.

This does somewhat restrict my choice of Android apps to those grown-up enough to recognise external drives, and it complicates my mental image too because now there are three separate memory spaces to consider: the cloud, the Chromebook's internal memory and the USB drive. Such triplicity turned around to bite my hand, albeit mildly, recently. I'd started getting messages that the computer was running low on space, and the Files app showed that only around 30MB of the 24GB internal memory was free.

It turns out, unsurprisingly, that most of the space was being eaten up by Android apps, which appear under a tree called Play Files (named after the Android Play Store). Within that tree, 6.5GB of the space was being consumed by the subfolder Android/data, and when I peeked in there I felt a familiar creeping spine-shiver – familiar because it reminded me of years of trauma in the dank, dripping Windows Registry. It seems that most Android apps you install create their own subtree, but few remove it fully, or indeed at all, when you uninstall

them. And it was then that I discovered you can't delete folders in Play Files using the Files app, because you lack the Linux permissions.

After an exciting couple of days during which I saw

“I felt a familiar creeping spine-shiver – familiar because it reminded me of years of trauma in the dank, dripping Windows Registry”

ChromeOS naked – not a pretty sight – an alternative file manager called Cx File Explorer told me that Play Files is really called system/storage/emulated/0, and the USB drive is called “system/storage/7875C92D409CB3B4F21633193CC4E1DFSAE2FAB7” (system programmers are a curious breed, a bit like that bloke in *The Hurt Locker*). It also let me delete most of the cruft, with much pondering over which might still be important. One alone, DCIM, the digital camera folder, still resisted deletion and reported its size as 635GB, clearly absurd. Eventually I nuked that one from orbit using the Linux console and nothing broke: photos now arrive in Downloads just fine and I can keep a workable 6GB of free internal memory.

The moral of this story? I still like Android a lot; it's an excellent cushion-cover for the prickly horror that is Linux, and I've even acquired the ability to write GUI apps in Python for it. At the same time, I'm not ashamed of my belt-and-braces affection for local storage, and hope that Lenovo's partnership with Esper will prod Google into completing the proper integration of ChromeOS with Android that it promised back in 2015 but never delivered. Given Microsoft's never-ending nightmares with post-10 Windows versions, and given a whole generation reared on Android phones, Lenovo could be on to a winner if it dares go beyond its stated targets of the retail, hospitality and healthcare industries and tests whether keenly priced Android PCs could become giant killers.

[dick@dickpountain.co.uk](mailto:dick@dickpountain.co.uk)

“It all works remarkably well, and the common fallacy that there aren't any grown-up Android apps is not true”

# Google's forced smiles are family deepfakes

The latest Pixel phone can borrow a smile from another photo, but real memories are better than AI-perfected ones



Nicole Kobie is PC Pro's Futures editor. The one sure way she can get a photo of her toddler smiling is to turn the camera into selfie mode – her own face always elicits a grin. Kids these days, eh? X@nikobie

I have a friend back in Canada named Daorcey – yes, that's how he spells it – and he can't smile in a photo with his eyes open. Over our 25-year friendship I have amassed a large collection of photos of him with eyes scrunched shut. This has inspired a secondary set of photos of Daorcey in which someone stands behind and attempts to hold his eyelids open. As you can imagine, those are unflattering, terrible and hilarious.

I wouldn't give them up for anything. Yet Google believes we'd all prefer photographic perfection. The Pixel 8 phone includes an AI-driven feature called Best Take that can swap faces from different pics to fix a misplaced blink or scowl.

Best Take only nabs facial features from photos of the same person taken at the same time; it's not going to search out the one picture where you're smiling from two years ago or borrow someone else's eyeballs for chronic blinkers like Daorcey. Nor will it generate a fake smile for someone who just can't manage it. Of course, it remains an option; you can leave your pics unadulterated. But the

"captured a moment", but in reality prefabricated detail was being slapped on to give people better snaps – and make the phones' cameras appear more capable than they were.

This one Pixel phone isn't the only place such eye-faking and face-altering shenanigans are happening, of course. Social media filters, in particular those on Instagram and TikTok, have altered faces for years, but don't pin that on selfish Gen Z youngsters – smoothing filters are also in videoconferencing software such as Zoom.

There are even efforts to use AI to fake eye contact in video calls, so it appears that you're always looking directly at the webcam rather than your own display. One example is Nvidia's Eye Contact, which replaces users' eyes with fake ones generated by AI, though the company suggests it's best saved for public talks, not personal calls. Fake eyes are also being constructed by Apple for the front of its Vision Pro headset, created by combining the wearer's real eyes as captured by cameras with their digital avatar.

Does it matter?

There's no question that photo filters affect aesthetic norms, making them even less attainable than before. But while fake eyeballs for video

and AR aren't dystopian, merely weird and off-putting, real harm is caused by disinformation and other malicious AI photo editing.

I'll admit that I do turn on the prettifying face filter in Zoom – it seems silly not to. But if all our photos are AI perfected, and the wrinkles smoothed out of my Zoom meeting face, how do we know what we even look like any more? No wonder I find looking in the mirror so painful sometimes – it's a surprising

disappointment compared to the virtual, magical mirrors of our smartphones. Beauty standards are already largely unattainable, but this constant digital perfecting means our faces won't be able to live up to our own photos.

**“Beauty standards are already largely unattainable, but this digital perfecting means our faces won't be able to live up to our own photos”**

And our faces matter, especially our expressions and eyes. I have captured photos of my husband with a look in his eyes that I'd never want AI to touch – shame about the weird thing he's doing with the rest of his face. Family photos would naturally be easier if we could just take 20 images and remix the best faces for the ultimate snap, but it's a lie that forgets the chaos that happens when a family all tries to look in the same direction at once. And my toddler daughter rarely smiles when asked; I have dozens of snaps of her turning her mouth into a dead-straight line, like the neutral face emoji.

I treasure the photos where both of us look happy – her face clean, her smile beaming, and I don't look too tired – but I'd rather those were few and far between and I got to keep the weird faces she pulls when she's bored of the camera. I want to remember her personality, not just her face.

I do have a few nice photos of myself and Daorcey kicking around. But the ones that bring a real smile to my face – one that doesn't need AI to generate – are the goofy pictures of his eyes half closed or his wife Natalie prising his lids apart. AI and algorithms know we like smiling in photos, but they haven't got a clue why we're so happy.

work@nicolekobie.com

**“As technology, it's remarkable. But it's also terrible. I want authenticity in my memories, not falsified perfection”**

aim, according to a Google manager speaking to the *Washington Post*, is to “capture the moment the user thought they captured”.

As technology, it's remarkable. But it's also terrible. I am not a professional model, nor is Daorcey. My family photos end up on Christmas cards, not magazine covers. I want authenticity in my memories, not falsified perfection. Remember Samsung faking zoomed-in photos of the moon? People thought they had

# GPT hits the spot for me – and could do for you, too



Barry Collins is a former editor of *PC Pro*. He hasn't been this excited since *T.J. Hooker* hit British screens. **X** @bazzacollins

Highly tailored AI assistants are making a genuine difference to my work life, and even making me less miserable in the process

**N**ever have I felt this torn over the topic of a column. On one hand, I've watched the prime minister turn into a Poundshop Parkinson in his eagerness to please the luminaries of the AI industry, leaving me yearning to gouge out my soul with a teaspoon; on the other, I've spent an inordinate amount of time creating highly personalised AI assistants with OpenAI's new GPT tools and I think they're the best thing since the KitKat Chunky. This AI lark is more divisive than Brexit.

James O'Malley does a fine job of dissecting the AI Safety Summit on p10, so let's focus on the positives here (something you never thought you'd read in this column, eh?) and talk about my new obsession: GPTs.

In case you've missed them among the blizzard of AI announcements in recent weeks, GPTs are a new feature of ChatGPT. They let you create personalised AI assistants that are dedicated to a specific task: helping you to learn chess, smartening up your monthly sales reports, tidying up the CSS on your website, for example.

The stroke of genius here is that you don't need to be a coding wizard to create a GPT. ChatGPT asks you simple, plain-text questions about what you want your GPT to do, how you want it to respond, which data/sources it should refer to... and the GPT effectively builds itself. If it doesn't deliver the answers you require, you can keep feeding the GPT new instructions until it rights itself.

I'm staggered how good they are. For example, part of my professional existence is producing podcasts, which involves a lot of fiddling with

Adobe Audition. It's a great piece of software, but it's a complicated bugger, too. There have been more than a few times over the past few months when I've resorted to Google searches or YouTube videos to help me reduce echo on a voice track, or scrape out mouse clicks, or remind me how to make the "ducking" of music against voice tracks smoother.

**S**o, I decided to create an Adobe Audition Assistant GPT. I pointed the GPT at the official Audition support site, in case it needed to look up how to do something. I told it I was a reasonably proficient user, so it didn't need to dumb down the advice, and that I ideally wanted tips delivered as step-by-step bullet points so that I wasn't continually wading through long passages of text. And I told the GPT I was using a Mac, so it could tailor advice on any keyboard shortcuts.

It listened and took the advice on board – and a few test questions where I already knew the correct answers convinced me the AI wasn't hallucinating or bluffing. It delivered concise, easy-to-follow solutions that save me from having to wade through ad-strewn YouTube videos or Adobe's far from brilliantly organised support site to get answers when I need them. It's already come in handy a few times, my only complaint being it can sometimes take a minute or two to spit out full answers.

Another niggly part of my freelance living is that every publication I work for has a different style guide. For example, *PC Pro* might want dates written in a specific format, which is different to that of Forbes. Trying to remember the names of my own children is a challenge, let alone whether Tim wants to see a space between numerals and weight

**“At a stroke, ChatGPT has gone from an entertaining but expensive plaything to something that's making a genuine difference to my work life”**

measurements. Thus I end up regularly infuriating sub-editors with out-of-style copy (sorry, Steve).

**A**gain, GPT comes to the rescue. As I mentioned earlier, GPTs can be trained on your own data. So to see how this worked, I uploaded the Forbes style guide (the one I have the most trouble remembering) and told the GPT to treat this like gospel, paying particular attention to the fact that this Essex-born scrote is constantly lapsing into UK English and colloquialisms that Forbes rather frowns upon.

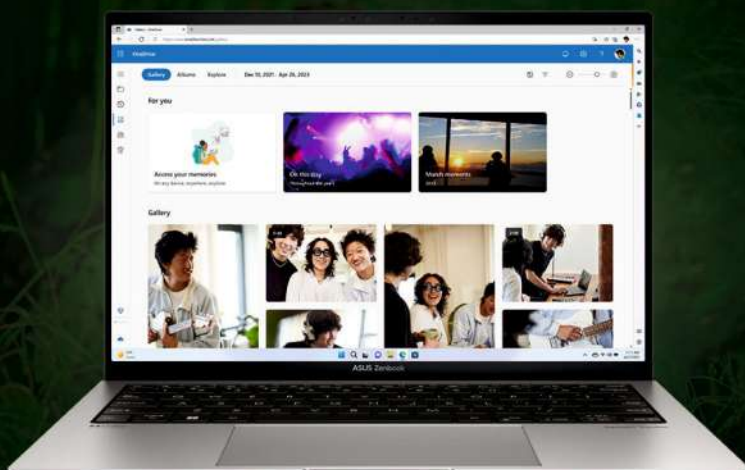
Now, before publishing, I can post an article into my Forbes Style Assistant and get a detailed breakdown of all the things that infringe the style guide. I don't want the AI editing my copy, as there blandness lies, but it will point out if I've omitted to put the full stops in "U.K." that Forbes demands, or I've got a measurement format wrong, or if I've incorrectly capped job titles. It's like having my own sub-editor, without the weary aggression every time I split an infinitive.

At a stroke, ChatGPT has gone from an entertaining but expensive plaything to something that's making a genuine difference to my work life and more than justifies that \$20 a month fee. And I don't think I've even scraped the surface of what's possible with GPTs yet.

I know I shouldn't be this enthused about AI, that I'm in danger of having to hand in my "Designated Misery Guts" badge, but this is exciting stuff. God, I'm beginning to sound like Sunak.

**barry@mediabc.co.uk**

**“OpenAI's new GPT tools are the best thing since the KitKat Chunky. This AI lark is more divisive than Brexit”**



# ASUS Zenbook S 13 OLED

Discover the world's slimmest OLED ultraportable laptop crafted with eco-friendly materials!



180° hinge for easy sharing



Supercharged performance



1cm ultra-thin & 1KG super-light



Long lasting battery life



All round sustainability



True-to-life 2.8K OLED display



Windows 11

Easier to manage your everyday

Learn More - Visit the ASUS website





# Readers' comments

Your views and feedback from email and the web

## Smart home, loose privacy

I read with interest your article on smart homes (see issue 351, p76) as I have earned more scars than most in this arena. I note you recommend Home Assistant for those that don't want to share their homes' innermost workings with US tech giants, but there's something more troubling at the hardware end of this market. What many people don't realise, or perhaps don't care, is that smart device manufacturers find it tricky to link devices in an unknown home network, so instead their devices phone home as soon as you connect them to your Wi-Fi and remain permanently connected.

If you flick a switch in your living room it's easier for the manufacturer if the data goes via its servers on its way to the light in the corner of your room.

We tolerate this from Amazon or Apple as it's essential for the services they provide and they have a reputation to protect, with UK and US laws to keep them honest. But what about the Smart Life app that many of the devices you reviewed use? I have friends with 20 or 30 devices



**ABOVE** How smart is allowing an app access to your network?

controlled through the Smart Life app, and yet they have never spent a penny on the app or its significant infrastructure, which is run by the Chinese company Tuya. An outage anywhere from China to the phone line in your road will render your smart house anything but, and who wants increasingly complex IoT devices in every room that maintain a connection to servers outside of our legal jurisdiction?

The alternative is something like Home Assistant, with any local webhook supporting devices (maybe something from Shelly, sadly absent from your reviews) and a basic grasp of your home network's IP addresses.

You can then have a light switch talking just across the room to only the light. That sounds smart to me.

**Alan Ingram**

## One last thought

A belated response to Jon Honeyball's "One Last Thing" piece about the hypothetical Ethernet sniffing device planted in an MD's office to bring down the company (see issue 350, p130). I do wonder whether the rise of outsourcing for things such as email makes the scenario described less likely or less damaging. If you planted such a device in the Ethernet cable going to my desk, you'd pick up traffic to Office 365 (encrypted end to end), OneDrive (ditto) and various internal wikis and apps. As it happens, we have run all our internal websites and apps behind HTTPS for some years now, but I suspect this would be the weak spot where intercepted traffic would be easily readable from most companies. Not sure you'd see many emails, though.

**David North**

**Contributing editor Jon Honeyball replies:** You're absolutely right, your Office 365 traffic would be encrypted by HTTPS. But there's still a lot of traffic on a LAN that might not be encrypted – Synology servers, for example, don't have HTTPS by default for the management interface. Nor might

## Star letter

### Too much regulation?

I have enjoyed reading *PC Pro* for 20 years or more. You have a bright and interesting editorial team. The *PC Pro* podcast has also been informative.

But recently I realised I am in the process of completely disengaging from your whole operation. This is due to the increasingly shrill and ridiculous call for more and more regulation from Lee and Tim, particularly on the podcast.

Calling for ever more regulation of industry is repetitive, puerile and after a while really boring to hear. You are simply suggesting that a central planner, deep in the corridors of Whitehall or Brussels, will have the skills to construct and control our economy in a way that you feel is somehow "better". This has been tried over and over again. The results are always the same. Low productivity and growth,

worse living standards. The economy we are beginning to see around us right now.

It is selfish, depressing and predictable that you always call for regulation of other industries, rather than publishing, where you would be directly affected. How will you feel when our government starts to regulate against the carbon production that comes from printing magazines? When they ban paper magazines and cause your revenue to drop by 50%, will you realise the damage these pointless rules do? Can you ask Lee how he would feel if government decides that all PC repair operatives require a certificate that takes five years to complete, or must shut up shop?

Government regulation is corruption on steroids. It allows bureaucrats to pick winners in industry, motivated at best by their own perverse views, at worst by grubby backhanded incentives which only come to light years later.

The free market regulates itself. Poor products and companies eventually fail. But it can take time and patience for this to happen, I acknowledge.

I hope that even at this late stage, a change in editorial approach can be begun.

**Andy Large**

**Editor-in-chief Tim Danton replies:** Thanks for your well-considered email, Andy. I definitely take your point that regulation comes with all sorts of problems, even if I disagree with you suggesting that Lee and I are shrill in our call for more of it! And if people disagree, or have alternative solutions to the genuine concerns that we often raise, then I'm all for hearing them. I don't have an inherent love of red tape.

It would be a little odd for a magazine dedicated to technology to talk about regulation of publishing, a totally different sector, but in Lee's defence he has actually suggested in the past that the repair world needs qualifications (see *Tech Repairs: Who Can You Trust?*, issue 334, p32).

Does the free market regulate itself? I fear that we're moving too far into politics, so I will resist pursuing that point any further!



This month's star letter writer wins a Cherry KW 7100 Mini BT keyboard plus Gentix BX mouse, worth £75 – and appropriately finished in Cherry Blossom. Email [letters@pcpro.co.uk](mailto:letters@pcpro.co.uk)

**POP3/SMTP be encrypted by default. And this little box lets you have a remote shell on the network, which opens up all sorts of nefarious opportunities.**

### Always listen to Davey

Just a quick note re Davey Winder's Windows 10 options in your big feature about the operating system's demise (see issue 350, p31). I started reading – yeah, yeah, I thought. I have auto update on, so no problem.

A nagging curiosity made me look today. Updates have failed for several months, so I'm still on 21H2. I looked up the error code (download error 0x80070643) and then downloaded and ran the NetFxRepairTool.exe. So far, all updated to 22H2...

Thanks Davey!

**Roger Preston**

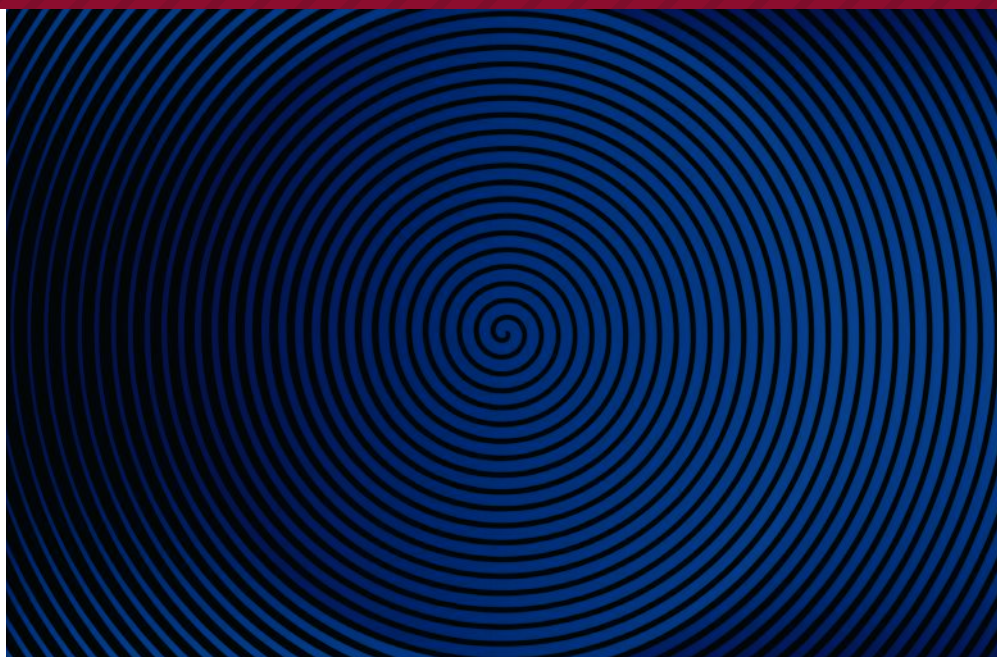
### Minty fresh

I was impressed that your correspondent Nik Rawlinson recommended Linux Mint as an alternative to the waning Windows 10 in issue 350. I have been using Mint for several years now and really like it. My laptop and desktop are both configured with Windows 10 and Mint. I find I barely use Windows 10 for anything any more. Even when I updated my printer to an Epson EcoTank with Wi-Fi, the built-in cups printer driver allowed me to print directly from my laptop using Mint. Perhaps you could run a few how-to articles about Mint for those you encouraged to switch.

Excellent magazine, by the way.

**Bill Power**

**Editor-in-chief Tim Danton replies:** Thanks Bill, for both writing in and for the compliment! Our next planned coverage of Linux is in issue 354, when we have a Labs dedicated to Linux distros, but we will definitely consider more practical articles about using Mint and alternatives in the future.



Thanks to everyone who left their extremely interesting comments on this one. Let's start with Nick Kitchen (@NukesSix), who described smart glasses as "the mobile phones of the past in a futuristic world in the now yesterday". Which we had to read a couple of times, but yes, we're with you! "I'd like some but I'd put them down somewhere and lose them so I'd need a second pair to tell me where the first pair is, then I'd sit on those so I'd need a third reserve pair."

Matthew (@matthew1471) also raised an excellent point about privacy. "Bluetooth speakers are amazing but I wouldn't use one in a busy shopping centre. Being aware of your surroundings, whether it disturbs and how you look to others is important."

Meanwhile we're a little concerned about @Ectopoint. "Even though I'm 55 I often pretend I'm the Terminator seeking my prey with digital situational updates. If smart glasses bring this to reality then I'm in. By prey I mean coffee shops, not Sarah Connor." Thank you for the clarification.

But we'll leave the final word to Graham Watts. "Battery technology needs to move on a long way to make them viable. If they're not broadly in line with the size, weight and comfort of current glasses then I think mainstream adoption is going to be unlikely."

“I miss Google Glass. It was a brilliant idea, ahead of its time.”

**@mrg9999**

“Smart lenses that replace the ones in your eyes are the real solution. Fix eyesight issues, as well as giving advanced functions.”

“Only once they offer a prescription option at a reasonable price.”

“No for the general public BUT for us geek folk, hell yeah.”

**Daniel Mackey**

“Probably, once there's a simple and unobtrusive way to finely manage and interact with the content displayed. Top tip, blinking ain't it.”

**John Moore**

## Join the debate



Join the growing **PC Pro** community on Facebook at [facebook.com/pcpro](https://facebook.com/pcpro)

Get the latest news and updates by following us **@pcpro**



Email us at [letters@pcpro.co.uk](mailto:letters@pcpro.co.uk)

## SUBSCRIBE

To subscribe to **PC Pro**, visit [subscribe.pcpro.co.uk/offer](https://subscribe.pcpro.co.uk/offer).

For existing subscriber queries, visit [mymagazine.co.uk](https://mymagazine.co.uk), email [pcpro@servicehelpline.co.uk](mailto:pcpro@servicehelpline.co.uk) or call 0330 333 9493.





# ***HOT HARDWARE OF THE YEAR***

We pick 22 of the hottest bits of kit and software from this year's *PC Pro* podcast – and add eight great gift ideas

**CONTRIBUTORS:** Barry Collins, Tim Danton, Darien Graham-Smith, Lee Grant, Jon Honeyball and Rois Ni Thuama

**E**very week on the *PC Pro* podcast, one member of the team nominates their Hot Hardware of the Week. It's not necessarily a brand spanking new item. It's not necessarily hardware, as we choose software and services, too. But it is an interesting piece of tech that we think deserves wider attention.

In this feature, we're rounding up our 2023 Hot Hardware highlights. We've got more than 20 nominations from this year's podcasts, plus a selection of more festive stocking fillers, if you're still on the lookout for a gift for the techie in your life.

Regular listeners to the podcast will know that not only do the other team members get to vote on whether an item is hot or not, but we let the listeners who join us live every week vote in an online poll, too. The vast majority of the items listed here were voted winners, but we've sneaked in a few that didn't quite make the cut. What's the point of running your own magazine if you're going to let readers dictate everything?

On each of our mini-reviews, you'll see who nominated the item, plus a reference to the podcast in question, in case you want to go back and listen to the full item with everyone's opinions. Hot Hardware is the final item on every show, so scroll forward until you reach 10-15 minutes from the end to listen to that segment.

Regular listeners will know that editor Tim Danton has earned himself something of a reputation as a lemon-backer in the Hot Hardware stakes, but this reputation is somewhat unfair. At the time of writing, Tim has a 50% success rate in 2023, and in fact it's Darien Graham-Smith with the worst hit-rate of all, with a lowly 33%. (To be fair, Darien has voted against his own nominations on two occasions!)

Barry Collins and Jon Honeyball both share a success rate of 63%, but it's Lee Grant (who suspiciously provided these stats) who has a 100% win record in 2023. Podcast newcomer Rois Ni Thuama has yet to enter the lion's den, for those keeping score.

If you want to make your feelings known on Hot Hardware, join us live for the *PC Pro* podcast at [pccpro.link/discord](https://pccpro.link/discord) every Thursday at 1pm UK time.

## GEEKOM AS-6

Price: £699 from [geekom.co.uk](https://geekom.co.uk)

Nominated by: Barry on podcast 647

The Geekom AS-6 offers an incredible amount of power for the price. A Ryzen 9 6900HX with integrated Radeon 680M graphics, 32GB of RAM and 1TB of hard disk are all packed into its tiny frame, yet it costs less than £700. You might think that's decent enough for day-to-day duties, but it can handle gaming, too. Titles such as *Fortnite* and *Rocket League* are playable at high-quality settings even at 4K, although dropping down to Full HD delivers perfect



## GIFT IDEA

### AMAZON KINDLE SCRIBE

Price: £330 from [amazon.co.uk](https://amazon.co.uk)

When we first reviewed the Scribe (see *issue 341*, p62), we weren't overly impressed, giving it a three-star rating. Since then, Amazon has trickled out updates that added the features it should have had at the start, turning this into a hugely versatile tablet. Superb for reading books and magazines thanks to its 10.2in E Ink screen, and it's now an excellent journalling tool, too. The addition of "write-on" books in the Kindle store adds yet another dimension.



smoothness. With a 2.5Gbits/sec Ethernet port, Wi-Fi 6E and Windows 11 Pro all included, it's arguably the PC bargain of 2023... if you're willing to take a gamble on the company's less than comprehensive support.

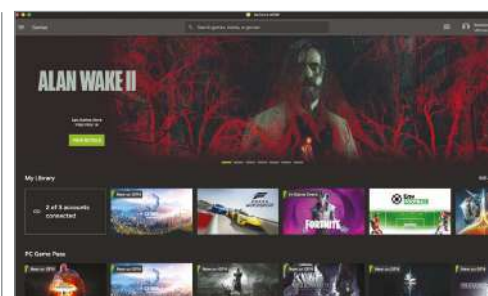
**DARIEN SAID** "I love mini PCs, I have since the first NUC. Always when you look at these things, you think what's the compromise? And I've got to say, it's pretty much nothing. I don't require high-end gaming graphics, it's got a decent number of fast USB ports, it's got lovely fast wireless and wired networking, and the price is almost suspiciously good."

## NVIDIA GEFORCE NOW ULTIMATE

Price: £17.99 per month from [nvidia.com](https://nvidia.com)

Nominated by: Barry on podcast 631

Barry was one of the first journalists in the world to get a demo of GeForce Now's Ultimate tier at CES 2023 – and he was suitably impressed. Pitched side by side with a RTX 4070-based gaming rig, he found it impossible to tell apart the performance of the high-end PC and the streaming service. Based on RTX 4080 pods, and delivering games at 4K resolution at up to 120 frames per second, GeForce Now Ultimate still sets the bar for games streaming services almost a year on. It genuinely does cast



into doubt the wisdom of spending several grand on a gaming PC.

**DARIEN SAID** "I think the future of gaming is something like this. It's definitely more Netflix than Blockbuster. But the price is a bit of a problem – after two years of that you might as well have bought a PlayStation 5. Still, Nvidia has scope to drive those prices down. It's pointing in a great direction."

## SONY CINEMA LINE FX30

Price: £2,100 from [sony.co.uk](https://sony.co.uk)

Nominated by: Jon on podcast 627

Described by Jon as a "deeply, deeply gorgeous" 6K video camera, this is a model pitched directly at professionals. It has an APS-C sensor and is based on Sony's E-mount, meaning there's a huge range of lenses that can be attached to this compact camera. It can record at 120 frames per second for flawlessly smooth slow-motion footage. Auto-focus capabilities are superb, with exceedingly accurate eye-tracking ensuring your subjects never drift out of focus. Aside from lenses, don't forget to budget for CFexpress Type-A cards you'll want to feed this thing with. It can take two at once, allowing you to guard against card failure.

**LEE SAID** "Going back to my TV days, a good pro camera was amazingly expensive, well beyond the realms of what we're looking at here. To get as much technology in your pocket as this gives you, for that money, it's a no-brainer really. Hot all the way."





## POLY STUDIO PREMIUM USB VIDEO BAR

**Price:** £675 from [amazon.co.uk](https://www.amazon.co.uk)

**Nominated by:** Jon on podcast 633

When you spend as much time on videoconferencing calls as Jon does, you want something more sophisticated than a laptop webcam pointing at you. The Poly Studio Premium USB video bar is a great addition to any conference room table. Its beam-forming mics help identify the current speaker, and the 4K camera zooms in on whoever is talking with its 120° field of view, helping multi-attendee meetings run more smoothly. Audio quality is superb and it makes even Teams meetings less of an ordeal.

**BARRY SAID** "As someone who's spent an awful amount of time on videoconference press launches, struggling to hear what anyone in the room is saying, if this works as well as Jon says it does, it's a hot from me."

## LEGO CAT D11 BULLDOZER

**Price:** £350 from [amazon.co.uk](https://www.amazon.co.uk)

**Nominated by:** Jon on podcast 634

If you need to take your mind off work for a bit but still want to feed your inner nerd, nothing brings quite as much enjoyment as getting elbow deep in Lego bricks. This Cat D11 Bulldozer kit is more than just a model: once it's assembled, you can download the app and drive the beast around your dining room table, scaring at least three lives out of any real cats nearby.

**LEE SAID** "These things are just phenomenal pieces of engineering,



and it ticks so many boxes that I like about fixing and tinkering and playing. Unfortunately, in my life, there are four words that ruin this for me: Dad, can I help? So, sadly, I wouldn't pay for one, but it's an absolute hot."

## ACER SPATIALLABS VIEW PRO 3D MONITOR

**Price:** £1,450 from [store.acer.com](https://store.acer.com)

**Nominated by:** Tim on podcast 635

Glasses-free 3D viewing that you can take with you? That's what's on offer from the Acer SpatialLabs View Pro, which aside from the rather steep asking price needs a powerful laptop with decent dedicated graphics to power it. Still, if you're working in 3D design and need something to show your concepts to customers, this 15.6in, battery-powered 4K display could well be precisely what you're looking for. Tim thought it was one of the most impressive things

he saw at CES 2023. It's even capable of adding

## GIFT IDEA

### SHOKZ OPENFIT

**Price:** £179 from [uk.shokz.com](https://uk.shokz.com)

You probably know Shokz – it rebranded from AfterShokz a couple of years ago – for its bone-conduction headphones. It has now released earphones, with a loop that tucks behind the ear to keep it in place and to connect to your bones. They're ideal for runners who like to stay aware of their surroundings, and while music will never be as immersive as, say, the Sony WF-1000XM5 (£319), you'll still enjoy tracks, and voices come through clearly – great for taking calls on the move.



3D depth to games, although support for apps such as 3ds Max and Blender will tick the boxes for design pros.

**DARIEN SAID** "I like to dream that we'll have view-from-anywhere 3D sooner rather than later, and this is a step towards that, so I say hot."

## MIDJOURNEY

**Price:** From \$12 per month from [midjourney.com](https://www.midjourney.com)

**Nominated by:** Barry on podcast 636

While the world was still marvelling at the text-to-image abilities of DALL-E in the early part of 2023, it was another generative AI model





## INSTA360 X3 CAMERA

Price: £459 from [store.insta360.com](https://store.insta360.com)

Nominated by: Jon on podcast 640

If you find yourself pottering around St Mark's Square like Jon did in April, desperate to capture the magnificence of your surroundings, you'll want something like the Insta360 X3 in your pocket. This 48-megapixel camera captures a full 360-degree view at 60fps, meaning you won't miss a single thing. The superb software lets you adjust the frame after the event, so if you want to capture your other half bombing down the ski slopes, you simply point the camera in their vague direction and either manually adjust later or let the AI weave its magic. There are all sorts of attachments you can add to the basic camera for diving, motorbike and car capture, too.

**DARIEN SAID** "The idea you can capture the entire scene and then, in the comfort of your editing suite, pull out the bits you want to share – I like it, it's hot."

that caught Barry's attention. Midjourney's ability to accurately render almost any text prompt you could throw at it was enough to earn version 5 of the AI model a Hot Software endorsement. Midjourney is particularly strong at rendering faces, something other AI models struggled with at the time, although recent improvements to DALL-E and Adobe's Firefly have seen the competition close the gap. Being forced to use Midjourney via Discord is both weird and somewhat intimidating for



newcomers, although the company is working on a dedicated website/app that should soon remove that obstacle.

**LEE SAID** "It's absolutely scorching. I first saw an image Barry posted and said 'is that AI?'. Having shown it to a few other people, they didn't spot it was AI at all. If you're running a generic stock photo library, I would be very worried."

## INTEL NUC 13 PRO

Price: £880 from [scan.co.uk](https://scan.co.uk)

Nominated by: Tim on podcast 637

Such is the weight of a Hot Hardware endorsement from the *PC Pro* podcast team that, er, Intel discontinued its NUC range after the NUC 13 Pro won our hearts in the spring. But if you can still find one of these in the dwindling stocks, it delivers a decent dollop of power in a compact desktop unit. As Tim pointed out, you could easily buy the optional VESA mount and attach it to the back of your monitor to create a DIY all-in-one with a 13th gen Core-i7 processor, 32GB of RAM and a nippy 512GB SSD that draws a maximum of 100W.

**DARIEN SAID** "I've been using a Mac mini as my desktop for the past few years, and I love everything about it, except it's not user upgradable, which the NUC is. If I were to jump back to Windows the NUC would be high on my shopping list. Hot, hot, hot."

## PANASONIC TOUGHBOOK 40

Price: From around £3,500 from [panasonic.com](https://panasonic.com)

Nominated by: Tim on podcast 638

This 14in laptop isn't designed to survive the 7.34 from Chipping Norton – it's designed to survive military manoeuvres in the desert. Hence everything about the Toughbook 40 is geared towards life outdoors, which is why it's rain-proof, dust-proof and comes with hot-swappable batteries that will keep the thing running all day – even if you don't switch the screen backlight all the way down to 2 candelas to prevent the screen glare

## GIFT IDEA

### LEGO AUDI RS Q E-TRON

£150 from [lego.com](https://lego.com)

If the Lego Cat D11 Bulldozer (see opposite) is too expensive, this Technic series alternative is – says Jon, a happy owner – "great fun". The Technic range tends to have mechanical features, such as complex pneumatic gearboxes and electric motors. "These are extra fun because the motor controllers are controlled from an app on your phone, over Bluetooth. This Audi is just one of a range of projects that use this. It's a great build, it's fun to play with, and it can



scoot across your lounge and deeply scare the cat."

**JON SAID** "The price is not in any way ridiculous – it's not a serious overhead at all. It's great these things exist. There's clearly a market for it and it's very good that they're satisfying it."

## MOTO G13

Price: £130 from [argos.co.uk](https://argos.co.uk)

Nominated by: Tim on podcast 643

Yes, your flippy-foldy phones are all very impressive, but not everyone wants to take out a second mortgage to buy a smartphone. The Moto G13 is





an immensely affordable handset that will do a perfectly serviceable job as your day-to-day smartphone. The 5,000mAh battery will easily get you through a day and a half, largely because it's not packed with the most powerful processors. Nevertheless, it's powerful enough to keep Android running smoothly. The 50-megapixel rear camera delivers sharp images, and the selfie camera is adequate, although you might not want to rely on it for macro photography. Now down to only £130, it's a great choice for a child's first smartphone or, frankly, for anyone who doesn't regard a phone as a status symbol.

**BARRY SAID** "I'd be very tempted to buy this if I were in the market for a phone. There's nothing exciting about the flagship phones any more. The lack of 5G does trouble me slightly, but for £130 you can't complain, so I say hot."

## VIRTUE XR GLASSES

Price: \$439 from virtue.com

Nominated by: Mark Parvin on podcast 644

Guest Real World Computing columnist Mark Parvin joined us in May to tell us why he'd backed this set of extended reality glasses on Kickstarter. In short, they offer a big-screen experience for any device that you might plug into them, such as the Steam Deck console or a PlayStation. The manufacturers claim it delivers the equivalent of a 120in screen – Mark says they appear much

## GIFT IDEA

### OURA RING (GEN 3)

\$299 from ouraring.com

It may have been released back in 2021, but Oura's third-generation device is packed with sensors to track your key metrics, such as 24/7 heart rate, temperature and more. It's particularly geared up to help you track sleep and manage energy levels. With so much data collected, it's good news that its app is both comprehensive and intuitive. The downside? It's expensive and you'll need to pay \$5.99 per month to access its premium features.



larger than the 50in TV he has in his living room when he's got them on. There are speakers on each arm, but they're not loud enough to disturb anyone else in the same room. You can plug in headphones to prevent that potential irritation, though. Power is delivered through the connected device, so there's no need to worry about battery life.

**JON SAID** "I like the idea, I like people trying to make this stuff work, but I'm finding it difficult to think this is going to be properly supported in four or five years' time, so I'm going to say not."

## SYNOLOGY DVA1622

Price: £544 (diskless)  
from broadbandbuyer.com

Nominated by: Jon on podcast 649

The DVA1622 was launched in 2022, but Jon gave it a thorough six-month



test before lending it his Hot Hardware nomination. This specific device uses GPU power to apply AI smarts to networked video camera footage. The device can automatically analyse up to 16 incoming video streams, alerting you when a specific person enters your office environment, or when a particular vehicle (via numberplate detection) enters the garage. It can count the number of people going in and out of entrances, giving you a heads-up about potential overcrowding. It can even detect if someone is wandering around without a face covering, helping to avoid potential regulatory issues in medical or manufacturing environments. The HDMI output lets you monitor the footage from multiple cameras, too.

**DARIEN SAID** "It's reasonably priced, it's got some useful features, it's very versatile and Synology has a great reputation for user-friendliness. I don't see what there's not to like. It must be hot."

## SMALLRIG MOBILE VIDEO CAGE KIT (DUAL HANDHELD)

Price: \$100 from smallrig.com

Nominated by: Jon on podcast 646

If you're serious about your phone photography or videography, this kit gives you easily grippable handles to hold the phone with two hands and make the photos/footage much more stable. If even the grips can't get the footage steady enough, the cage can be mounted on a tripod to eliminate shake. The cage, which offers additional protection for the phone in case it's dropped, also leaves room for the iPhone's MagSafe battery if you need extra juice while you're shooting. Originally nominated for the iPhone 14 Pro Max, the company makes similar models for a wide range of handsets, but predominantly iPhones.

**LEE SAID** "I'm all in with this. The amount of stuff you see on TV that is filmed on iPhones is stunning. This is



a great product at a cheap price, and it's hot every day of the week."

## ADVENTURE KIT: 30 DAYS LOST IN SPACE

Price: \$97 from [inventr.io](http://inventr.io)

Nominated by: Lee on podcast 650

You've taken a wrong turn on the satnav, lost signal and now you're lost in space. We've all been there. But with this brilliant little game kit you can build your way out of trouble and learn something about electronics at the same time. Primarily pitched at kids, this cleverly packaged kit sets you various missions, such as repairing the solar array or preparing for launch, each of which requires you to use different parts of the kit, including the microcontroller, LEDs, screen, buzzer and dip switches. It's a tremendous Christmas present for budding coders. Keep an eye out on the website for various discount codes to bring the price down.

**JON SAID** "We're in an era where computing for most people is their mobile phone or a tablet. To actually get under the hood and start playing around with this stuff is important. It gets a hot from me."



### GIFT IDEA

## MARSHALL MIDDLETON BLUETOOTH SPEAKER

£270 from [johnlewis.com](http://johnlewis.com)

Available in black or cream, this stylish speaker packs an astonishing amount of bass for its size. Listening to music on it is a real treat, and a 1.9kg weight and 20-hour battery mean that it's an excellent travel companion, too. We also love that you can stack it to create a huge sound stage (although we didn't get to try this out), that it's weatherproof to IP67 ratings, and that you can use the USB-C to charge your devices from it in an emergency.



## PACKET SQUIRREL MARK II

Price: \$100 from [shop.hak5.org](http://shop.hak5.org)

Nominated by: Jon on podcast 654

Want to get a proper grip on your network? The Packet Squirrel Mark II is what Jon describes as a "hacker's toy", a dinky little Ethernet passthrough box that manages the TCP packets flowing through your network. You could use it to set up a DNS sinkhole, for example, redirecting all the DNS traffic to a particular domain to somewhere else. You could use it to record all the traffic that's passing through. You could set up a VPN client on it. It's what Jon calls a toy for grown-ups, so probably not a stocker-filler for the kids, despite its size.

**DARIEN SAID** "It's not something I would get much use out of, but I can imagine the sort of person who would find it magically useful. It's £100? That's nothing. Absolutely hot."

## ASUS RT-AX59U ROUTER

Price: £125 from [scan.co.uk](http://scan.co.uk)

Nominated by: Darien on podcast 653

We've covered plenty of mesh router kits over the past couple of years with four-figure price tags. The Asus RT-AX59U is at the more affordable

end of the spectrum, providing Wi-Fi 6 connectivity in a compact unit roughly the size of a hardback book. It has 3x3 MIMO, offering up to 3.6Gbits/sec across up to three clients simultaneously. Of course, the theoretical maximums are just that, but Darien found it performed well *chez* Graham-Smith, with a maximum download speed of 640Mbits/sec in his tests – more than enough for most domestic connections. The Asus software is superb, too, with strong options to configure your own VPN, parental controls and robust security.

**BARRY SAID** "There's nothing stand out here that makes me think I must have this thing, but there's a lot of nice features, especially the one where you can funnel only certain traffic through a VPN."





## ROLLING SQUARE AIRCARD

**Price:** £33 from [rollingsquare.com](https://www.rollingsquare.com)

**Nominated by:** Jon on podcast 661

This licensed device is a credit card-sized equivalent of the AirTag, Apple's tiny tracking device. Unlike the AirTag, it doesn't have a replaceable battery and it relies purely on Bluetooth to detect neighbouring Apple devices that can help pinpoint its location. The built-in battery should last two-and-a-half years and, once it reaches end of life, you can return it to the company and get 50% off a new unit. If someone saintly finds your wallet, they can even scan the QR code on the unit and get your contact information.

**ROIS SAID** "I really like it and I'm just waiting for the Android version."

## JACKERY EXPLORER 1500 PRO PORTABLE POWER STATION

**Price:** £1,499 from [jackery.com](https://www.jackery.com)

**Nominated by:** Barry on podcast 628

Cast your mind back to the winter of 2022-23, when Russia's invasion of Ukraine and the subsequent oil and gas shortages raised the very real prospect of rolling power cuts in the UK for the first time in many decades. Thankfully, a mild winter meant such measures weren't required, but devices such as the Jackery Explorer 1500 Pro would help keep your home office running if the power does go out. Indeed, when Barry's home suffered a power outage in the summer, it did just that, powering his router, laptop, monitor and other peripherals for four hours with plenty of the 1,512Wh battery to spare. It's

heavy, but portable enough to take on camping trips, and optional (but expensive) solar panels can help top up the Explorer 1500 when you're away from the mains.

**LEE SAID** "I'm afraid it's not doing it for me. I know a few people who've got the earlier versions of this and the problem is trying to get enough sun on the solar panels to make it usable."

## ARC MAX

**Price:** Free from [arc.net](https://arc.net)

**Nominated by:** Barry on podcast 662

There have been a million and one AI tools launched in 2023, but Arc Max is one of the few truly useful ones. Likely to become a subscription-based service for the Arc browser but free at the time of writing, it infuses AI



## GIFT IDEA

### DIVOOM TIMEBOX EVO

£44 from [divoom.com](https://divoom.com)

Listen to the *PC Pro* podcast before Christmas and you may well hear Lee suggesting the Divoom Timebox Evo as his "Christmas cracker". This compact Bluetooth speaker is roughly 10cm square and weighs a shade over 300g, and Lee assures us "that Bowie sounds foot-tappingly sweet. But you'll forget about sound quality once you've been mesmerised by the vibrant array of 256 RGB LEDs, which can be fully customised by the companion app. This turns the Divoom into an alarm clock with calibrated lighting, a desktop social media notifier, animation studio, weather station and a pile of other functions. Kids' mode allows grown-ups to lock it down, so it's also a magnificent gift for little ones. It's £44 and fabulous."



services seamlessly into the original Mac browser. Shift-click on a link, for example, and you'll get a short bullet-point summary of what the page contains, often saving you from having to click through. Press Command+F on any web page and you can interrogate its content with your own questions. It's a far better implementation to the rather tacked-on AI you get with Bing.

**LEE SAID** "This is as unbrowser-like as I think you'll find. It's more of a research tool with AI and browser capabilities bolted in. But as a tool I think this is really quite interesting, so it's a hot from me."



## SAMSUNG GALAXY Z FLIP5

Price: £1,049 from johnlewis.com

Nominated by: Jon on podcast 655

The biggest improvement to the 2023 version of Samsung's flip-phone is not that bendy screen on the inside, but a much larger screen on the exterior, saving you from



## GIFT IDEA SONOS ROAM

£179 from sonos.com

"If I'm not out on the hills walking the dogs, I'm in the garden chillin' with my hose," said Rois when we asked her for Christmas gift ideas. "Spending time in my garden, pulling weeds and hanging with my hounds isn't a chore, but it would be infinitely better if I had a portable speaker. As a long-time fan and consumer of Sonos speakers, this Christmas I have my heart set on a Sonos Roam. It's practical for my purposes (waterproof, dustproof and drop-resistant), it has a ten-hour battery life, is voice-enabled, and the setup is super easy. And if Santa's bothering anyone for details, I'd like the red one, please."



having to prise open the device to read and reply to messages or check Google Maps, for example. The Flip 5's hinge has been redesigned so that the two sides of the screen fold flush together, all but eradicating the gap that would gather pocket lint. However, the trough in the middle of the screen when it's fully open remains annoyingly visible. But with Jon's original version of the Flip still in active use many years later, he's got no worries about the flexible screen's durability.

**ROIS SAID** "I like the fact you can fold it and stick it in your pocket and it's not materially bigger. You had me at that. It's handbag-sized, and compact is useful."

## LG GRAM SUPERSLIM

Price: £1,599 from currys.co.uk

Nominated by: Tim on podcast 645

The SuperSlim rivals the MacBook Air in terms of sheer slenderness, but it's by no means sacrificing performance for its lean frame. The 12-core Core i7 processor and 16GB of RAM, not to mention a very nippy 1TB M.2 Gen4 SSD, help the SuperSlim rattle along. The Intel Iris Xe graphics can even cope with modest 3D gaming. There are no concerns about battery life, either, with the laptop lasting almost 16 hours when left idle and nigh on 12 hours in our video-rundown tests. The only big disappointment is a meagre Full HD resolution spread across that expansive 15.6in screen. It's expensive, but if you value portability above all else then the LG Gram SuperSlim is one of the choice laptops of this year.

**BARRY SAID** "I picked up the 16in version at CES and was astonished at how light it is. But a Full HD resolution on a screen that big is bananas."

## GIFT IDEA SUBSCRIBE TO FUTURE PUBLISHING'S TECH TITLES

Future Publishing produces a range of superb magazines, and subscriptions create a gift that just keeps giving. Head to [magazinesdirect.com](https://magazinesdirect.com) for the latest offers. ●

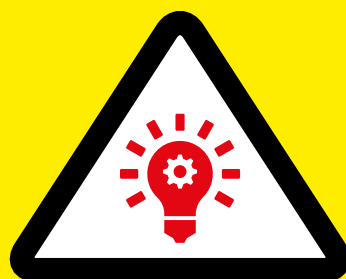




How you're  
most likely to be

# HACKED/ SCAMMED/ INFECTED in 2024

Nik Rawlinson explores how to  
protect yourself from the most  
common attacks and exploits



It might be a while since you last experienced a major malware attack – but the threat hasn't gone away. Cybersecurity specialist SonicWall reports that there were more than 5.5 billion malware attacks recorded in 2022. And simply keeping your security software up to date may not keep you safe: cloud solutions provider Mimecast found that more than 90% of successful hacking attacks are now enabled not by traditional malware, but by someone unwittingly clicking on a phishing email.

If you want to minimise your risks, you need to recognise the biggest threats, and know how to avoid them – whether that's via your computer, your mobile devices, your website or your smart devices.

## YOUR COMPUTER

If it seems like the days of major virus outbreaks are behind us, that's because operating systems have got much better at blocking this type of threat. Windows and macOS both have built-in safeguards to prevent applications from performing dangerous actions such as meddling with your system settings and replicating themselves – at least without your permission. This is what's happening when Windows asks "Do you want to allow this app to make changes to your device?"

However, the effectiveness of these safeguards depends on the user paying attention, and not reflexively clicking "Yes" on apps they don't know to be trustworthy. If you've downloaded an installer from an official store or the original manufacturer, the risk may be minimal, but if you get apps from sketchier sites – or via BitTorrent – they could be bundled with a malicious payload. At its most benign, this might be some unwanted utility

or browser toolbar; at the opposite end of the scale, it could be a Trojan or even ransomware.

However, while installing untrusted downloads is a sure way to compromise your own security, it's not the most common. Hackers and other malicious actors increasingly take a sneakier approach: in 2021, three-quarters of hackers said that traditional firewall and antivirus protections were obsolete in an age when they could instead use social engineering to gain access to privileged accounts.

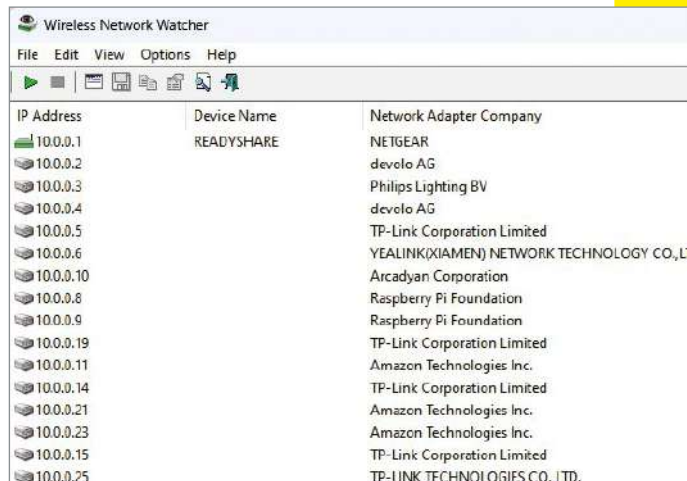
Verizon's 2023 Data Breach Investigations Report found that 74% of breaches "involved the human element, which includes social engineering attacks". The UK government's latest cybersecurity breaches survey confirmed that 79% of businesses and 83% of charities had experienced phishing attacks over the previous 12 months. By contrast, viruses, spyware and malware accounted for just 11% of business-focused attacks and 9% of attacks on charities, while ransomware affected 4% in each category.

Your best defence, therefore, isn't technical but mental: you need to be suspicious of anything that arrives by email, and very wary of sharing personal information that could be exploited. You might also choose to use a VPN to encrypt your communications: this won't prevent you from inadvertently entering sensitive information into a phishing site, but it will block snoopers from spying on your network traffic or your Wi-Fi connection.

There are lots of VPNs to choose from; our A-List pick NordVPN ([nordvpn.com](https://nordvpn.com)) costs £86 for two years, but if that's too much for you, our second choice

ProtonVPN has a free tier ([protonvpn.com/free-vpn](https://protonvpn.com/free-vpn)), which can be used with a single device connecting through servers in the Netherlands, US and Japan. Both NordVPN and ProtonVPN maintain a no-logs policy, and they're based in jurisdictions that further protect your privacy (Panama and Switzerland respectively). Opera also offers a free VPN service for in-browser use ([opera.com/features/free-vpn](https://opera.com/features/free-vpn)).

There are plenty of other VPN services to choose from, but treat unfamiliar brands with scepticism: all of your network traffic will be



IP Address	Device Name	Network Adapter Company
10.0.0.1	READYSHARE	NETGEAR
10.0.0.2		devolo AG
10.0.0.3		Philips Lighting BV
10.0.0.4		devolo AG
10.0.0.5		TP-Link Corporation Limited
10.0.0.6		YEALINK(XIAMEN) NETWORK TECHNOLOGY CO.,L
10.0.0.10		Arcadyan Corporation
10.0.0.8		Raspberry Pi Foundation
10.0.0.9		Raspberry Pi Foundation
10.0.0.19		TP-Link Corporation Limited
10.0.0.11		Amazon Technologies Inc.
10.0.0.14		TP-Link Corporation Limited
10.0.0.21		Amazon Technologies Inc.
10.0.0.23		Amazon Technologies Inc.
10.0.0.15		TP-Link Corporation Limited
10.0.0.25		TP-LINK TECHNOLOGIES CO., LTD.

**ABOVE** Wireless Network Watcher can log and list your network devices

passing through their servers as you browse and work online, so it's essential that you trust them and understand what they're doing with your data.

Depending on your network hardware, it may be possible to set up a VPN on your router. This protects every device in your home, without your having to configure each machine individually. However, the VPN can impact on your connection speed – and remember that once you take your phone or laptop outside of your home network, it will no longer be protected.

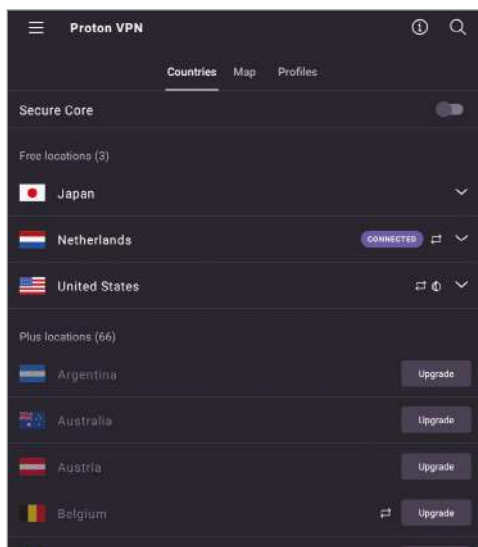
Another network-oriented measure you can take is to keep an eye out for unfamiliar or unauthorised devices – in truth this is an unlikely avenue of attack, but if a rogue device gets onto your LAN it could harvest data for nefarious purposes, or distribute malware across your devices. An app such as Wireless Network Watcher ([pcpro.link/352watcher](https://pcpro.link/352watcher)) can alert you to the arrival of new clients on your

network, and your router will normally allow you to block any devices you don't recognise.

## YOUR MOBILE DEVICES

Smartphones hold a significant quantity of personal data. Many of us use them as payment devices, they can track our movements, and they have access to our contacts, texts, photos and emails. This makes them a prime target for attack.

The most common way in which smartphones and tablets get compromised is via dodgy software installed from outside of the official app stores. In 2016, the European Union Agency for Cybersecurity (ENISA) warned that users should avoid third-party sources to minimise the risk of installing a malicious



**LEFT** ProtonVPN's free tier is ideal for a single device



application; the following year, the US Department of Homeland Security issued a report affirming that “users should avoid (and enterprises should prohibit on their devices) sideloading of apps and the use of unauthorised app stores”.

To be fair, sideloading doesn’t always have to be problematic – both Apple and Google permit large companies to distribute their own in-house apps on company devices, but this requires special corporate configuration and managed accounts.

For individuals, sticking to the official stores lets you avoid a lot of bad stuff. In 2020, Apple removed or rejected close to a million apps and updates from its App Store; almost a quarter were found to be violating privacy guidelines, while more than 150,000 were banned for being spam, copycat applications or misleading users. Apple also expelled 470,000 teams from its developer programme for fraud-related reasons, and rejected 205,000 enrolment attempts, again over fraud concerns.

Historically Google hasn’t been quite so strict about what gets into the Play Store, but the tech giant has recently stepped up its efforts to crack down on malware (see [pcpro.link/352appmalware](https://pcpro.link/352appmalware)), and its Google Play Protect technology automatically scans apps for potentially malicious behaviour. “Play Protect can’t keep all malware off of Android phones,” noted security consultant Joel Snyder, writing for Samsung, “but the risk is much higher when users install apps from the internet or hacker-specific app stores. For this reason, most Bring Your Own Device (BYOD) and Choose Your Own Device (CYOD) policies prohibit sideloading.”

Even with these safeguards in place, you should still check the reputations of the apps you download, and be cautious about anything unfamiliar. Researchers at VPN Check last year found that 84 potentially deceptive apps remained on sale through Apple’s App Store, 12 months after they’d been logged as malicious by antivirus firm Avast. “These apps are not necessarily malware, or viruses,” explained PC Pro’s sister site TechRadar Pro. “They might not try to steal data, damage, or destroy the endpoint they’re infecting. But they do try to incur extra costs for the



**LEFT** Downloading from official app stores gives you extra protection



**KEEP YOUR MOBILE DEVICES SAFE**

- Only download apps from official stores where possible
- Don't sideload apps unless through certified channels
- Don't trust apps from unrecognised sources

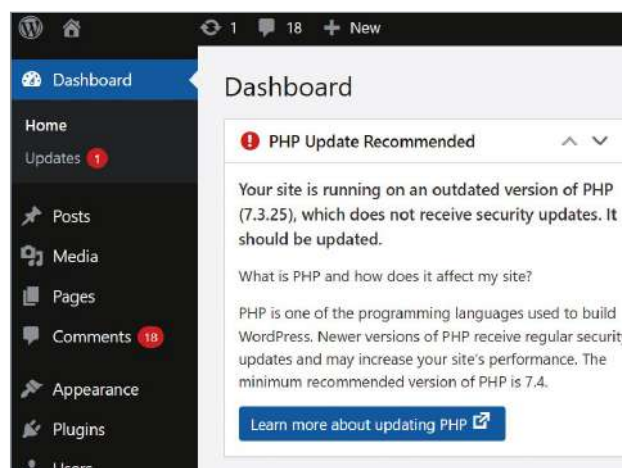
victims (either via hidden fees, premium subscriptions, or other similar mechanisms), and are relatively hard to eliminate from the devices.”

## YOUR WEBSITE

If you have a website, it’s probably hosted remotely, but that doesn’t mean you can afford to neglect its security. If your site is hacked via an unpatched exploit, it could be wiped – or encrypted by ransomware, leaving you with no good options if you don’t have an up-to-date backup.

To a certain degree, the security of your site and your online data is in the hands of your hosting provider. If they’re slow to update key web technologies, you’ll become more and more vulnerable as time goes on. Those technologies might include software and frameworks such as PHP, WordPress, Joomla and Drupal, plus any plugins you’re using. Check

**BELOW** This server is running an old version of PHP, increasing risks



that your site is using the latest versions – and if it’s not up to date, either patch the software yourself or demand that your provider updates it on your behalf.

Realise, too, that it’s not just your own data you need to worry about: you also have a responsibility to your website visitors to keep your site secure. A hacked server could be used

as a launch point for attacks on other servers or services, and if you’re storing sensitive data on your server – or in a linked database – this could leak, exposing you to potential legal action. One of the most common ways that this happens is via a SQL injection attack, where a malicious actor enters deliberately crafted code into an input box, which is interpreted by the underlying database as a query or instruction, rather than data. It’s your responsibility to make sure any input fields on your site aren’t susceptible to this type of exploit.

Another popular type of attack is cross-site scripting (XSS for short), in which hackers embed malicious content on your pages, which is then executed in the visitor’s browser. It may be possible to defend against XSS content using JavaScript, or by disabling scripts altogether where this is practical.

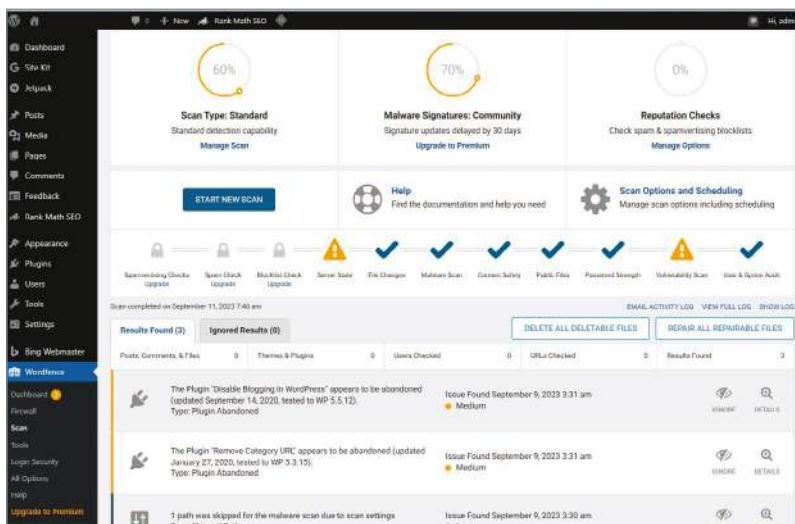
If you’re looking to tighten up your website security, a good start is to install an SSL certificate, which you can do for free via Let’s Encrypt ([letsencrypt.org](https://letsencrypt.org)). This won’t protect against the types of attack above, but it does provide encryption between your site and the visitor’s computer, making it harder for snoopers to steal sensitive information.

If you’re running WordPress, we’d also recommend using a tool such as Wordfence ([wordfence.com](https://wordfence.com)). This guards against unauthorised logins with IP banning, rate limiting and



**KEEP YOUR WEBSITE SAFE**

- Keep all software, databases and plugins up to date
- Guard against SQL injection, cross-site scripting and other vulnerabilities
- Consider installing additional security software



**ABOVE** Wordfence can block unauthorised users and monitor your site for changes

easy 2FA – and, more than this, it checks your site against other exploits seen on the Wordfence network and monitors files on your server for unauthorised or unexpected changes. It's easy to install from the WordPress repository, and the free tier will go a long way towards hardening an entry-level or personal site. For the full feature set you can sign up for the \$119 per year Premium plan, which includes real-time firewall rules, malware signature scanning and a dynamically updated IP blacklist.

## YOUR SMART DEVICES

Smart home devices from big-name manufacturers shouldn't normally be a major security concern – but don't be complacent. Doorbell manufacturer Ring found itself the subject of a class action lawsuit after hackers took over users' devices. According to *The Guardian* ([pcpro.link/352ring](https://www.theguardian.com/technology/2023/sep/11/ring-doorbell-hackers)), one Ring user claimed that, while he was watching TV one

night, his camera asked "What are you watching?" Another alleges that his children were addressed by an unknown hacker through the device, who commented on their basketball play and encouraged them to approach the camera.

As for doorbells from rival Nest, *Which?* found that "hackers were able to exploit a Denial of Service (DoS) attack, which effectively is a way to spam the device with requests so that it goes offline. An attacker could use this to stop your doorbell from recording if they want to approach your home" ([pcpro.link/352which](https://www.which.co.uk/news/articles/2023/09/nest-doorbell-hack/)).

It goes without saying that, to minimise the chances of exploits such as these, you should ensure your smart devices are running the most recent firmware available. Frequently, they'll update themselves automatically, but it's often possible to perform a manual check through any associated smartphone apps. Once a smart appliance is no longer

## CLOUD SERVICES

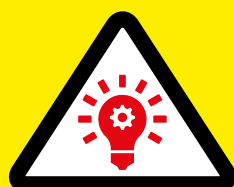
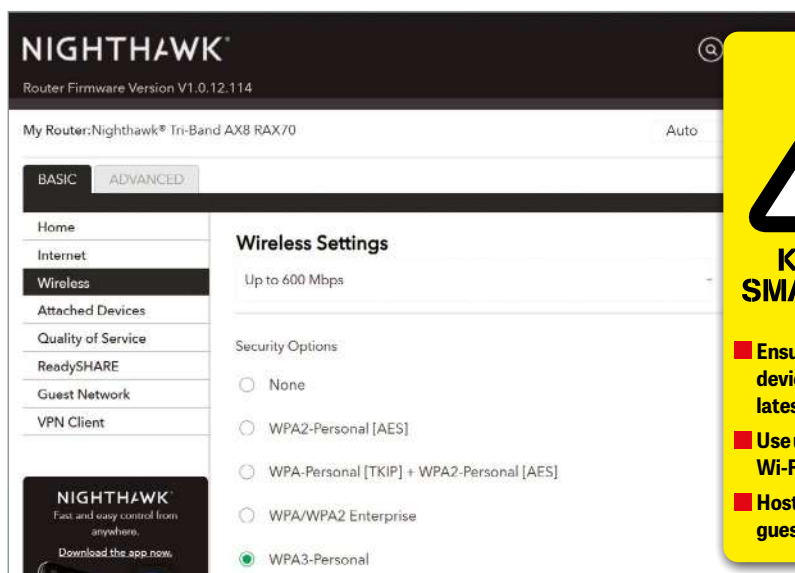
When it comes to online services such as Gmail or OneDrive, privacy and security are generally handled entirely by the provider: you'll get little or no visibility or control over the technical or architectural side of things. This is because the resources that power your cloud account are almost certainly shared with thousands or millions of other users; it's simply not practical for the vendor to leave security up to individual users.

If you're buying into a software-as-a-service product, therefore, it's critically important to do your due diligence, especially for businesses (see p104). Check for compliance with the ISO 27000 family of standards for information security management, and in particular ISO 27017 and ISO 27018. The former is a code of practice that aims to reduce the risk of security problems in cloud environments; ISO 27018 is concerned with privacy and minimising risk when handling personally identifiable information in cloud environments.

Although it's not exactly a security concern, you should also consider how you're going to get your existing data into a cloud service – and how you might get it out again at the end of a long-term contract. Moving accounts or databases between online services may be difficult or even impossible: your best option might be to start from scratch at the start of the next financial year, after exporting historic records as PDFs, spreadsheets or an alternative interchange format. Consider, too, how you'd continue to function if the service suffered an outage, or even unexpectedly went out of business: keeping local copies of your data can reduce your exposure.

For businesses that have multiple users accessing SaaS platforms, accounts must be regularly audited, to ensure no-one can access anything they shouldn't be able to; where possible you should also check login times, locations and activities. One of the most common ways that businesses are exploited is via employees abusing their access, or being tricked into giving away passwords or other sensitive information. Implement 2FA where possible, mandate the use of strong, complex passwords on all accounts – and it goes without saying that access must be promptly revoked when someone leaves the organisation.

**BELOW LEFT** Use WPA3 encryption across your network if your router supports it



### KEEP YOUR SMART DEVICES SAFE

- Ensure that all smart devices are running the latest firmware
- Use up-to-date, robust Wi-Fi encryption
- Host IoT appliances on a guest network

supported by the manufacturer, consider replacing it.

Aside from firmware updates, settings and options on IoT and smart home devices are normally fairly minimal, so if you want to improve their security you'll need to do it at the network level. You should of course change the default passwords on any smart devices you're using, and ensure the wireless network has strong encryption – ideally the latest WPA3 standard. If your ISP router doesn't support this, you can pick up a cheap WPA3-compliant router for under £100, which you can connect to your existing router to broadcast a secure wireless network – just be sure to turn off Wi-Fi on your old router.

For maximum safety, it's a good idea to connect your IoT devices to a guest network, rather than the main one that handles your computers and phones. This ensures that even if a smart appliance is completely compromised, it's isolated from any devices that might contain personal information or exploitable software. ●



# RASPBERRY

## Your next desktop PC for £59

The lightweight, British-made Pi is perfect for everyday desktop duties. **Nik Rawlinson** explains how to get started

**T**he new Raspberry Pi is here, and it's better than ever, with a big boost in processor power and enhanced peripheral support. What's more, the price is still absurdly low. It's hardly surprising that when the first shipment of Raspberry Pi 5 boards arrived in October, they sold out almost immediately – although that might also have something to do with the post-pandemic chip shortage, which for the past few years has made most Raspberry Pi models almost impossible to buy.

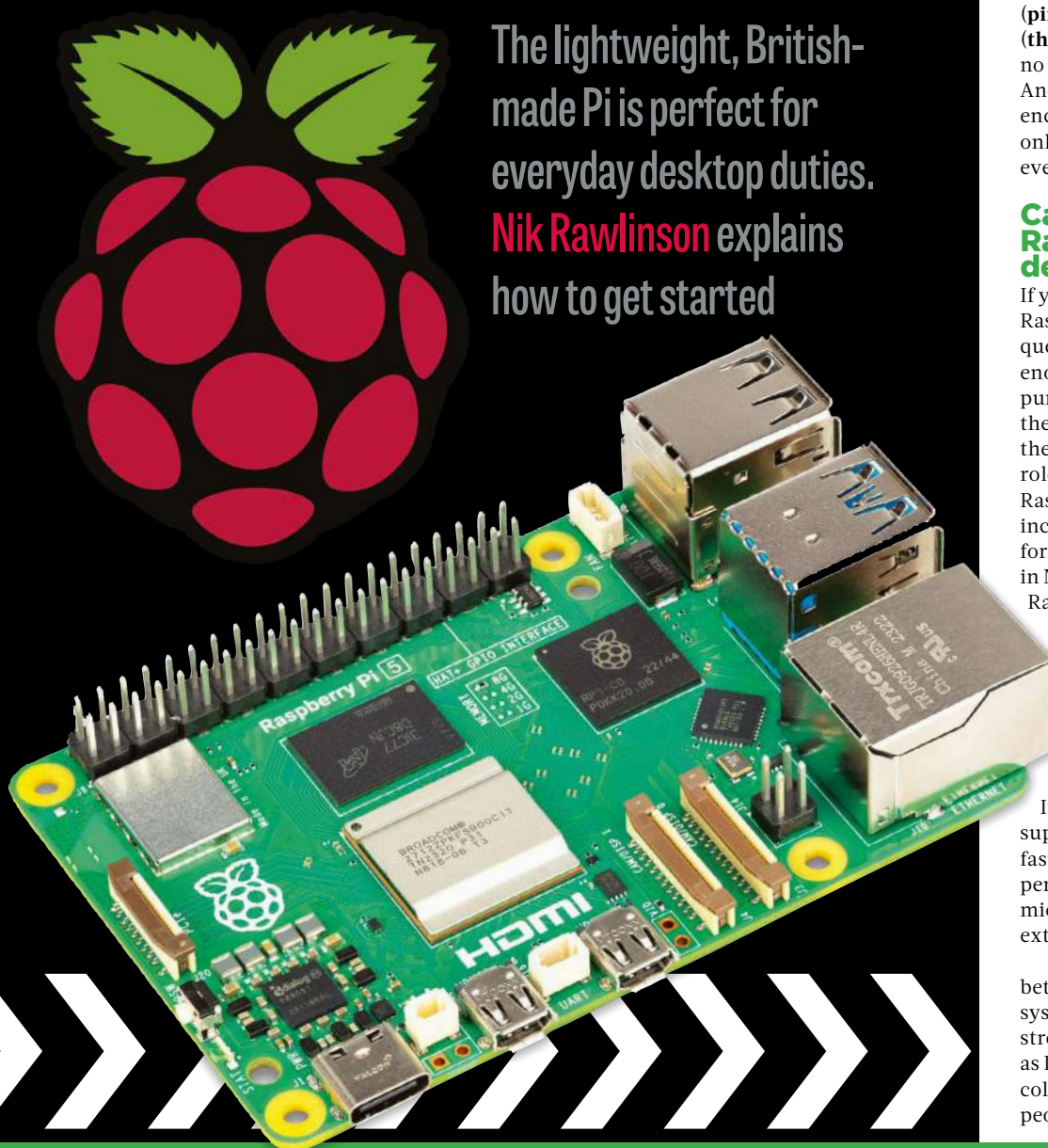
Happily, more Raspberry Pi 5 boards are already hitting the shelves via suppliers such as Pimoroni ([pimoroni.com](http://pimoroni.com)) and The Pi Hut ([thepihut.com](http://thepihut.com)), so you should have no difficulty getting hold of one. And perhaps for the first time, we'd encourage you to consider one not only for hobbyist projects, but as an everyday desktop computer.

### Can you really use the Raspberry Pi 5 as your desktop PC?

If you've tried using an older Raspberry Pi board, you might question whether it's fast or flexible enough to use as a regular, general-purpose PC. But recent versions of the hardware have already proven themselves viable for a desktop role: when the pandemic struck, Raspberry Pi said it saw a rapid increase in the use of Raspberry Pi 4 for home working and studying, and in November 2020 it unveiled the Raspberry Pi 400, with a compact keyboard inspired by classic single-box machines such as the BBC Micro and ZX Spectrum.

The new hardware in the Raspberry Pi 5 takes things to the next level, with all the power you need to be productive. It also comes with upgraded USB support, meaning you can connect fast external storage and other peripherals: you can even ditch the microSD card and boot from an external SSD.

Software support keeps getting better, too. The official operating system goes from strength to strength, while free software such as LibreOffice allows you to collaborate effortlessly with people using Microsoft Office.



# PI 5

The bundled version of Firefox is now optimised for Raspberry Pi, with particular attention paid to desktop sharing and video-call performance – ideal for working from home on your Pi. And if you're running Ubuntu elsewhere, you have the option of installing the exact same OS on the Raspberry Pi hardware.

Perhaps there will always be particular use cases and programs that work better in Windows or macOS. But the Pi is maturing, and at the same time more applications are evolving into web apps and cloud services. It's never been more enjoyable or practical to use the Raspberry Pi as your primary desktop computing platform.

## What's new in the Raspberry Pi 5?

We've already given away the Pi 5's headline feature: its speed. The fastest Raspberry Pi 4 model was built on an ARM Cortex-A72 chip clocked at 1.8GHz, but the new board uses a more advanced Cortex-A76 CPU running at 2.4GHz. That's a huge step up in computing performance; the GPU and system memory are also faster, and some core functions have been moved onto dedicated chips, providing further efficiency gains.

The new Pi provides some new interfaces, too. There are now two four-lane MIPI DSI/CSI connectors where the headphone jack and camera connector previously sat, and a PCI Express 2 interface where you'd previously have found the display connector. Wi-Fi 5 and Bluetooth 5 are built in, as before, but there's also now a battery-powered real-time clock module, and – for the first time – a power button built into the board itself. Pressing this once brings up the Raspberry Pi OS shutdown dialog; a second press immediately launches a clean shutdown.

Some other ports have been moved around. The gigabit Ethernet and USB ports have swapped places, returning

to the positions they occupied on the Pi 3 and earlier boards, while the 3.5mm headphone jack has disappeared, so you'll have to rely on Bluetooth or HDMI for sound output. The USB ports are now all full-size Type-A sockets, with two USB 2 sockets and two supporting USB 3; there's also a sole USB-C port, but that's only there for power. Remarkably, despite all these enhancements and updates, the Pi 5 costs only £4 more than the 2021 Raspberry Pi 4 Model B: you'll pay £59 inc VAT for the 4GB model, or £79 for the 8GB board.

## The ideal desktop setup

If you're buying a Pi 5 for desktop use, there aren't too many decisions to make. The computer itself currently comes only as a bare board (although we'd love to see a Pi 500 model with an integrated keyboard), in 4GB and 8GB variants. You can't upgrade the RAM after purchase, so we'd recommend the extra headroom of the 8GB option.

As with previous models, you can power the Raspberry Pi 5 from almost any USB-C supply, but the new model adds support for the USB-PD standard, and raises the power limit from 15W to a maximum of 27W, allowing it to power a full set of USB peripherals such as external hard drives. The official 27W supply can be had for a very reasonable £11.90.

Want to put your desktop Pi in a case? You probably won't be able to reuse an old one thanks to the updated board layout, but Raspberry Pi has revamped its distinctive red and white case to incorporate a heatsink and fan for just £9.90. Alternatively, there's already a good range of compatible third-party cases to choose from: we opted to pay £9.90 for the open-topped Pibow Coupe 5 case ([pcpro.link/352case](https://pcpro.link/352case)), which gives easy access to the GPIO pins. We also added the official Raspberry

**The Raspberry Pi 5 takes things to the next level, with all the power you need to be productive**



**1. Download and launch the Raspberry Pi Imager, selecting Raspberry Pi 5 as your device**

**2. Next, pick "Raspberry Pi OS (64-bit)" as your OS**

**3. Then select your memory card as storage**

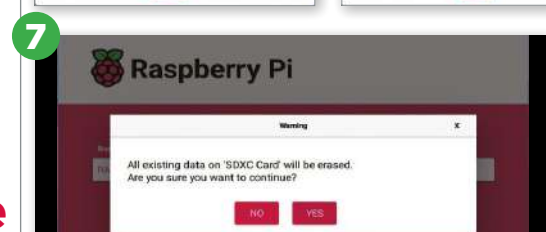
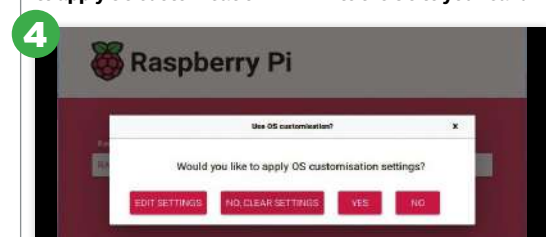
**4. When asked if you'd like to apply OS customisation**

**settings, we recommend you click "Edit settings"**

**5. You can now give your Pi a network name, create a username and password, and enter Wi-Fi settings**

**6. You might also want to enable SSH**

**7. Finally, tell the Imager to write the OS to your card**





## You'll be able to mount an NVMe SSD, bringing high-speed native storage to the Pi

Pi snap-on active cooler for £4.90, to ensure desktop performance isn't affected by thermal throttling.

Like its predecessor, the Pi 5 has dual video outputs capable of driving a pair of 4K displays at 60Hz, so you can use more or less any monitor you like. Since it uses micro-HDMI ports, however, you might need a micro-HDMI to regular HDMI cable: you can pick up the official Raspberry Pi version for less than a fiver through official resellers. Similarly, you can plug in any USB-compatible keyboard and mouse, or pay £28 for the admirably unfussy official Raspberry Pi desktop set.

There's one final component we'd love to add, but it's not yet available. The upcoming M.2 HAT will let you mount an NVMe SSD, bringing high-speed native storage to the Pi for the first time. This is expected to arrive by early 2024, and to cost around £20.

All told, our own desktop setup, comprising an 8GB Raspberry Pi 5, Pibow Coupe 5 case, official power supply, active cooler and micro-HDMI cable came to £111 exactly, including VAT. For the rest we used an existing monitor, keyboard and mouse, and recycled a spare 128GB microSD card as our Pi system drive.

### Setting up Raspberry Pi OS

Setting up the Raspberry Pi 5 for desktop use isn't particularly difficult, although as usual you'll need an existing computer with a microSD card reader to create the boot media. Start by downloading the Raspberry Pi Imager from [raspberrypi.com/software](https://raspberrypi.com/software) onto your PC, Mac or Linux system; then insert your microSD card, launch the Imager tool and click your way through the imaging process. To install the standard Raspberry Pi OS, select Raspberry Pi 5 as your device, pick "Raspberry Pi OS (64-bit)" as

**ABOVE** The Pi 5 uses a 2.4GHz Cortex-A76 CPU – a huge step up from the Pi 4



your operating system, and your memory card as storage.

When asked if you'd like to apply OS customisation settings, we recommend you click "Edit settings"; you can now give your Pi a network name, create a username and password, and enter your Wi-Fi settings. Doing these things now simply means you won't need to set them up when first booting up the Pi. You might also want to click on the Services tab and enable SSH, as this gives you the option of opening a remote terminal on the Pi (even when it doesn't have a monitor connected), which can be handy for remote maintenance tasks.

Finally, tell the Imager to write the operating system to your card. The time this takes will be determined by the speed of your PC and the card itself: in our case, it took around five minutes with a Class 1 card.

If you've used Raspberry Pi OS before (or its predecessor Raspbian), the latest release should be very familiar. However, one significant change is that the new OS uses the



**ABOVE** To connect to your Pi 5 using RealVNC you'll need to reinstate X11

Wayland windowing system in place of X11, as it's more secure and efficient. You probably won't notice a difference in everyday use, but the change does mean that the RealVNC remote desktop server is no longer supported: the new Pi OS uses wayvnc instead, which you can remotely access with a compatible client such as TigerVNC ([tigervnc.org](https://tigervnc.org)).

Alternatively, if you want to keep using RealVNC you can switch back to X11. To do this, open a Terminal window on the Pi 5 itself, or connect from Windows via SSH, and enter:

**sudo raspi-config**

Navigate down to Advanced Options and press Return; then navigate to Wayland and press Return. Press

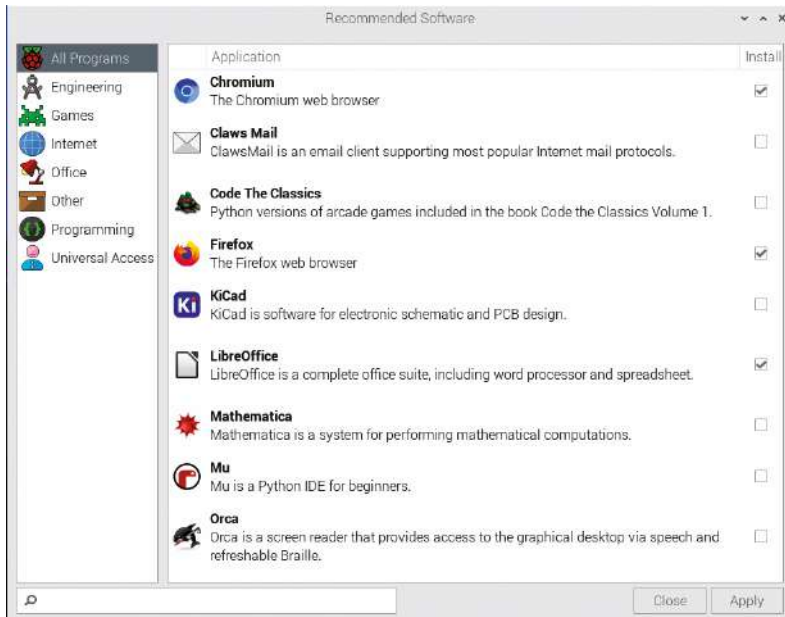
## We don't serve your type

The free LibreOffice suite interoperates very cleanly with Microsoft Office, but if you're sharing files with Office users, you may hit formatting issues because the Raspberry Pi OS doesn't include Microsoft's proprietary fonts. You can improve matters by installing the Microsoft Core TrueType Fonts pack, which contains 11 fonts including Arial, Verdana and Times New Roman. To do this, open a Terminal window on your Pi (the quickest way is to press Ctrl+Alt+T) and enter the following two lines:

```
sudo apt update
sudo apt install ttf-mscorefonts-installer
```

Unfortunately, the bundle doesn't include Calibri or Cambria, which are the default fonts in Office, and Microsoft doesn't offer a legal way to download and install them on your Pi.

One workaround is to download Carlito and Caladea from Google Fonts instead. These typefaces are metrically identical to the Microsoft fonts, as well as being similar in appearance, so you can substitute them without affecting the formatting or overall look of a document. When sharing back with Office users, you can embed the Google fonts in the document, advise your colleagues on how to substitute them, or distribute your work as a non-editable PDF file.



Return again with option W1 selected, press OK, then select Finish and allow the Pi to reboot.

## Running Ubuntu on the Pi

The Raspberry Pi OS is tailor-made for the lightweight board, but if you prefer to use an industry-standard Linux desktop, that's no problem. The Pi can run a range of ARM-compatible distributions, including the simple and popular Ubuntu platform.

You can set this up using the standard Raspberry Pi Imager tool. When choosing your operating system, click through to "Other general-purpose OS", then click Ubuntu. You can choose between Desktop, Server and Core (IoT) versions, and pick either the latest release or a more stable build with long-term support. Note the Imager tool can't set up your user account or networking configuration in the same way as it can with Raspberry Pi OS; you'll be dropped into the Ubuntu setup wizard when you first boot the Pi from your newly imaged card.

## Installing your applications

Once you've got your Pi set up, running and connected to the network, the last step is to set up your applications. Raspberry Pi OS preinstalls only a minimal software set, so – unless you want to rely on web apps – you'll need to install some programs to make your system useful. Start by browsing Raspberry Pi's recommendations, which you'll find by opening the Raspberry menu from the top-left of the screen, then selecting Preferences | Recommended Software.

We recommend LibreOffice for general productivity and GIMP for image manipulation; Inkscape is a

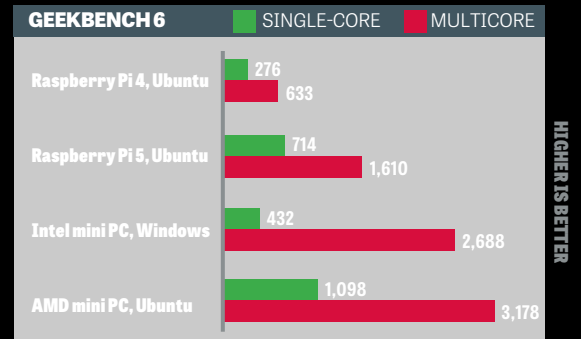
**ABOVE Raspberry Pi can run a wide range of software that has direct equivalents for both Windows and macOS**

powerful free vector graphics suite, and if you want to use your Pi for programming, Thonny is an excellent choice for working with Python and MicroPython. Each of these applications is also available for Windows and macOS, so your Raspberry Pi 5 can become part of a wider cross-platform workflow.

Other programs can be installed from the Raspberry Pi software store, which you can access by clicking Add/Remove Software on the Preferences menu. For anything web-based, Raspberry Pi OS includes both Firefox and Chromium browsers by default, and you can naturally install others if you have accounts set up elsewhere. And, needless to say, if you hit any problems or need advice, you can always turn to the huge, highly active Raspberry Pi and Linux communities for pointers. ●

## How fast is fast?

We've said that the Raspberry Pi 5 is fast enough to use as an everyday desktop machine, but what does that really mean? We used the Geekbench 6 benchmark to compare its performance to other low-cost computers.

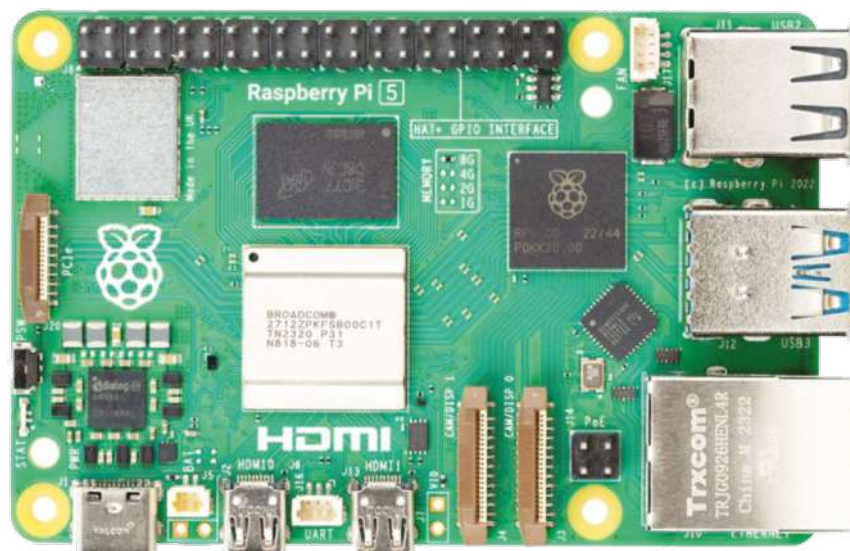


We started with a mini PC with 16GB of RAM, running Windows 11 Pro on an Intel N100 processor and costing £169 inc VAT. We then repeated the test on a second mini PC, this time on a much meatier quad-core AMD Ryzen 5 system with 8GB of RAM, costing £480 and running Ubuntu Linux.

Next, we tested the Raspberry Pi 4 Model B revision 1.4, with its 1.8GHz ARM processor and 8GB of memory – previously the most powerful model available, before the arrival of the Pi 5. We fitted an anodised aluminium heatsink on both sides to avoid processor throttling during our tests. Since there's currently no official ARM build of Geekbench for Linux, we used the preview build from [geekbench.com/preview](https://www.geekbench.com/preview), running on the latest release of Ubuntu as recommended by the publisher. Finally, we ran the same test on a Raspberry Pi 5.

As you can see from the graphs above, the Raspberry Pi 5 is a huge step up from the Pi 4. For both single-core and multicore performance it's more than two-and-a-half times as fast as its predecessor, and it even beat the Intel PC for single-core operations. It was no surprise to see that the Raspberry Pi 5 couldn't keep up with the AMD system, but considering it costs less than a quarter of the price it acquitted itself very creditably.

Perhaps more importantly, the Pi 5 *feels* fast in use. While using it we noted that web pages loaded snappily, and LibreOffice Writer launched in under four seconds. That's not far behind our Linux-based mini-PC, which took two seconds – and well ahead of the Windows test machine, which took 13 seconds to get LibreOffice Writer up and running.



**LEFT The Pi 5 provides some new interfaces, as well as a power button on the board itself**





# Run Windows on your Apple Silicon Mac for free



Boot Camp may have got the boot, but it's still possible to run Windows applications on macOS.

**Darien Graham-Smith** finds out how

**W**hen Apple migrated the Mac platform from Intel CPUs to its own ARM-based chips in 2020, it spelt the end for the Boot Camp utility. Windows simply couldn't boot on the new M1 hardware, so the popular dual-booting tool was quietly ditched.

However, if you still want to run Windows applications on your Mac, there is a way. For more than a decade, Microsoft has been working on bringing Windows to the ARM platform, and its latest releases are now more than mature enough for day-to-day use (see "What next for Windows on ARM?" on p42). If you want to try out some cross-platform action on your own Apple Silicon Mac, you can buy an ARM edition of Windows 11 from the Microsoft online store (see [pcpro.link/352win11](https://pcpro.link/352win11)) – or you can download the latest Insider Preview release and run it for free. Here's how.

## Expectation management

The great thing about Windows on ARM is that it has a built-in translation layer, which enables it to run existing Intel applications without modification. The ARM version of Windows 10 only works with 32-bit code, but the latest Windows 11 builds support 64-bit software, too, so you can run almost any application on ARM hardware. The main exceptions are programs that try to interface directly with the hardware or install their own system drivers, such as 3D games or third-party security tools – although the built-in Windows Defender is still there to protect you against online attacks.

This translation layer does, however, incur a certain performance penalty. What's more, since Apple Silicon doesn't support dual booting, Windows has to run inside a virtual machine, which means it can't make full use of your Mac's memory and CPU resources. The upshot is that Windows applications should still be perfectly usable, but they may feel sluggish and jittery compared to the snappy experience you're used to on your Mac.

Finally, bear in mind that Windows Insider builds come with no formal guarantee of stability or support. And while you're not legally obliged to activate your Insider OS (see [pcpro.link/352insider](https://pcpro.link/352insider) for the full terms of the programme), a few desktop customisation features won't be available unless you enter a valid product key.

In all, if you want to run Windows as your primary operating system, you'll probably get a better experience from a real Intel PC. But if you're happy using your Mac

**BELOW** You can join the Insider programme from within Windows 11



for everyday tasks, and just occasionally need to run a few specific programs in Windows, a virtual machine running Insider code could well be all you need.

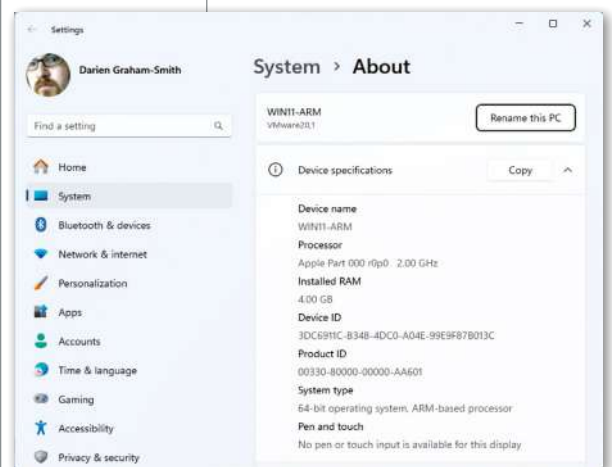
## Getting the Windows installer files

Right now, Microsoft doesn't publicly offer a downloadable installer for the "stable" edition of Windows on ARM, unless you buy it through the online store. However, it's easy to get hold of, as we'll see below. Just remember that it's not legal to use the commercial edition without a licence and product key.

If you prefer to take the free route, you can download the Insider Preview installer directly from Microsoft, as long as you're a member of the Windows Insider Preview programme. If you haven't already joined, you can register online at [pcpro.link/352register](https://pcpro.link/352register). You can also join via the Settings app on any PC running Windows 10 or 11, but doing it this way will configure that PC to receive pre-release OS updates, which may not be what you want.

Once you've enrolled in the Insider Programme, you can download the Windows 11 installation files for ARM from

**ABOVE** Windows happily recognises and supports Apple Silicon hardware



[pcpro.link/352arm64](https://pcpro.link/352arm64) (you may need to sign in to your Microsoft account again to confirm your Insider membership). The page will present a drop-down menu offering you three different builds of Windows 11: the Canary and Dev releases give you a chance to try out the very latest code, while the Beta version should be the most stable. After making your choice, hit Confirm.

Next you'll be prompted to choose your language; this isn't a hard decision, as at present the only option is US English. After you've selected this a download link should appear. The Windows 11 installer comes down the line in the form of a large (around 10GB) disc image file in Microsoft's VHDX format.

Having saved this file onto your Mac you can, if you wish, immediately cancel your membership of the Windows Insider Programme. To do so, visit [pcpro.link/352leave](https://pcpro.link/352leave) and click "Leave the program now" – or go back to the Windows Insider settings on your PC, scroll down to the bottom and click the "Leave the Insider programme" link.

## Choosing a host and preparing your installation media

macOS doesn't come with a built-in virtualisation host, but there are plenty of third-party tools to choose from. The slickest is Parallels ([parallels.com](https://parallels.com)), which supports some neat features such as running Windows applications directly on the Mac desktop. However, it costs £105 inc VAT for personal use – and that doesn't include a Windows licence. The best way to buy it is as a bundle, with the PC Pro store offering Parallels plus the ARM version of Windows 11 Pro for £130 ([pcpro.link/probundle](https://pcpro.link/probundle)).

# Windows on ARM has a built-in translation layer, which enables it to run existing Intel applications without modification



If you're looking for a free solution, you have a few other options. The open-source UTM hypervisor is one popular choice ([mac.getutm.app](https://mac.getutm.app)), but it has limited support for saving and resumable VM snapshots, so it's not ideal for quickly firing up Windows as needed. Another option is Oracle VirtualBox ([pccpro.link/352virtualbox](https://pccpro.link/352virtualbox)); this hasn't yet been officially released for Apple Silicon, but you can try out a Developer Preview of version 7.0.6 from the link above.

Our preferred free choice is VMware Fusion Player 13.5, a full, mature virtualisation host that's free for personal use: download it from [pccpro.link/352vmware](https://pccpro.link/352vmware). The catch is that VMware doesn't natively support VHDX files, so if you've downloaded your Windows 11 installation media in that format, you'll need to convert it into VMware's own VMDK format. But that's not hard: open a Terminal window on your Mac and, assuming your VHDX file is in your Downloads folder, enter these two commands:

```
cd ~/Downloads
/Applications/VMware/Fusion.app/Contents/Library/vmware-vdiskmanager -r Windows11_InsiderPreview_Client_ARM64_en-us_22598.VHDX -t 0 Windows11.VMDK
```

If your downloaded VHDX file has a different filename to ours then adjust the command appropriately. In a few moments you should have a new VMDK version of the installer file sitting in your Downloads folder.

## Creating the VM

When you first open VMware Fusion Player, you'll see a welcome window headed "Select the Installation Method". If you want to download the commercial release of Windows 11, click "Get Windows from Microsoft" and hit Continue. On the next page that appears, leave "Windows Edition" set to "Professional" (this also supports the Home edition), select "English (en-gb)" as your language, and hit the "Download Windows" button. Told you it was easy.

If you're installing from the Insider Preview image, instead drag the VMDK file you just created into the installation window. VMware Fusion Player will automatically detect the platform and architecture of your installer (Windows 11 64-bit ARM), so hit Continue.

## How long can you use Windows 11 Insider Preview for?

**When you first boot up Windows 11 on your Mac you may be rudely greeted by a banner telling you that your installation has expired. It seems Microsoft isn't updating its installation images all that regularly, so the OS you've just installed could be out of date on day one.**

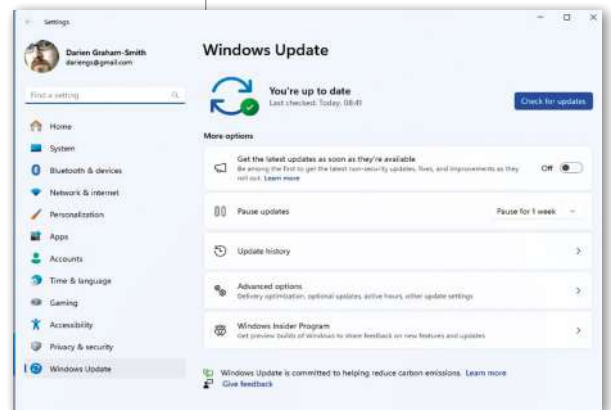
**Don't panic – you can keep using Windows for as long as you like. You simply need to periodically download the latest build via Windows Update, just as you would on an Intel-based PC. Even if you've left the Windows Insider Preview programme, your Insider OS will still receive the latest patches and builds as they become available. Note, though, that there's currently no off-ramp: if you want to leave the testing track and switch to release code, you'll need to carry out a clean reinstallation of the OS.**

From here the setup procedure is largely the same whether you're using your own VMDK or an automatically downloaded image. The next page that appears asks you to confirm UEFI BIOS emulation – which you can do by hitting Continue – then invites you to set up a password for the virtual TPM inside your virtual Windows machine. You can click "Auto Generate Password" for this if you wish; it will be saved in your macOS Keychain if you ever need to refer back to it (for example, if you want to move your VM to another Mac or access it from a different user profile).

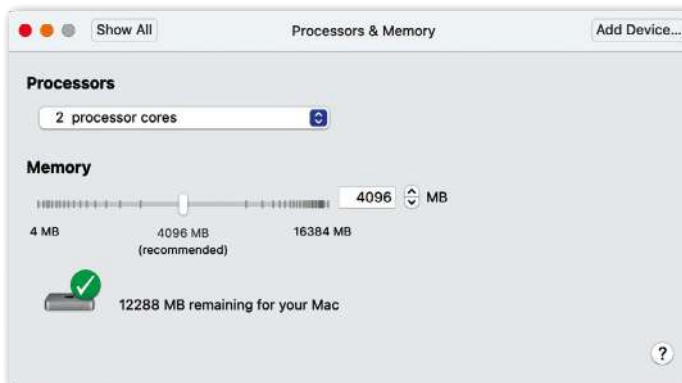
Hit Continue again to move onto the virtual disk setup page. If you're using the official installer downloaded by VMware, you can leave "Create a new virtual disk" selected and hit Continue. The default size is 64GB, but the image will only take up as much disk space as is needed to hold the files used by Windows – and if you need more space you can always expand it later.

If you want to install the Insider Preview, select "Use an existing disk", and navigate to your VMDK file in the requester that opens. Leave "Make a separate copy of the virtual disk"

**BELOW Keep your ARM edition of Windows updated in the usual way**



**BELOW You may get a smoother ride if you can spare more than 4GB of RAM for Windows**



selected so that you still have a clean copy of the installer just in case.

Hit Continue one more time and you'll see a summary of your new VM configuration. You can optionally click "Customize Settings" to tweak the virtual hardware; the default settings will assign 4GB of RAM and two processor cores to your Windows VM, which is fine for lightweight

desktop use, but you can increase these allocations if you want more headroom. Just remember that it's a balancing act, as these resources won't be available to macOS while the VM is running.

Once you hit Finish, VMware will prompt you to save your new VM, and you'll then see a black screen with a big "Play" symbol on it. You can click this – or the little icon at the upper left of the title bar – to "power on" your virtual machine.

## Installing Windows

Turning on the VM brings up a simulated BIOS screen. If you're using the full release version of Windows 11 on ARM, you'll see a message saying "Press any key to

**Our preferred free choice is VMware Fusion Player 13.5, a full, mature virtualisation host that's free for personal use**

## After more than a decade in the doldrums, it looks like Windows on ARM may finally get its chance to shine

boot from CD or DVD...” – and you should do this, as the installation files are on the virtual DVD drive.

You’ll then shortly see the legacy Windows installer interface. This will prompt you with a few basic questions such as your region and keyboard preferences, which edition of Windows you want to install and which hard disk you want to install it on. Once you’ve made your choices and started the installation process, the system will copy the files, reboot, spin for a few minutes, then launch the graphical setup wizard. If you’re using the Insider Preview, the installation files are already in place, so your VM should boot directly into the setup wizard.

Once you see the opening screen of the wizard (which asks “Is this the right country or region?”) you might naturally want to start working through it. Try this, though, and you’ll quickly run into difficulties, as the installer needs network access, which in turn requires us to install a driver.

To do this, open the Virtual Machine menu and select “Install VMware Tools” (or “Update VMware Tools”); on the requester that appears, hit “Install” to mount the virtual disc containing the necessary drivers. Next, press Shift+F10 to bring up a Command Prompt – or, if that doesn’t work, press Cmd+R to bring up the “Run...” requester and enter “cmd”. Now enter:

**d:setup.exe**

This will launch the installer for VMware’s tools and drivers. Click

through it, accepting the default options, and reboot the virtual machine when prompted. When the installer comes back up, you’ll now be able to complete the installation without any technical hurdles.

As part of the process the installer will ask you to name your device – something like WIN11-ARM should be nicely unambiguous – and whether you want to set it up for personal use, or for your work or school. Select the former, as this virtual machine isn’t on a corporate network, and log in with your Microsoft account.

The installer will also offer to bring across your OneDrive files, preferences and apps from your most recently used Windows device; if you prefer a clean installation, click “View more options” and choose “Set up as a new device”. You’ll then be asked to permit all sorts of telemetry and personalisation services; it’s a bit of a tiresome process, but you only have to go through it once.

Eventually, once you’ve been thoroughly questioned, the installer will spend a few more minutes building your user profile, and you’ll finally be greeted by the familiar Windows desktop. What you do from here is up to you: you may well want to start by installing your commonly used programs.

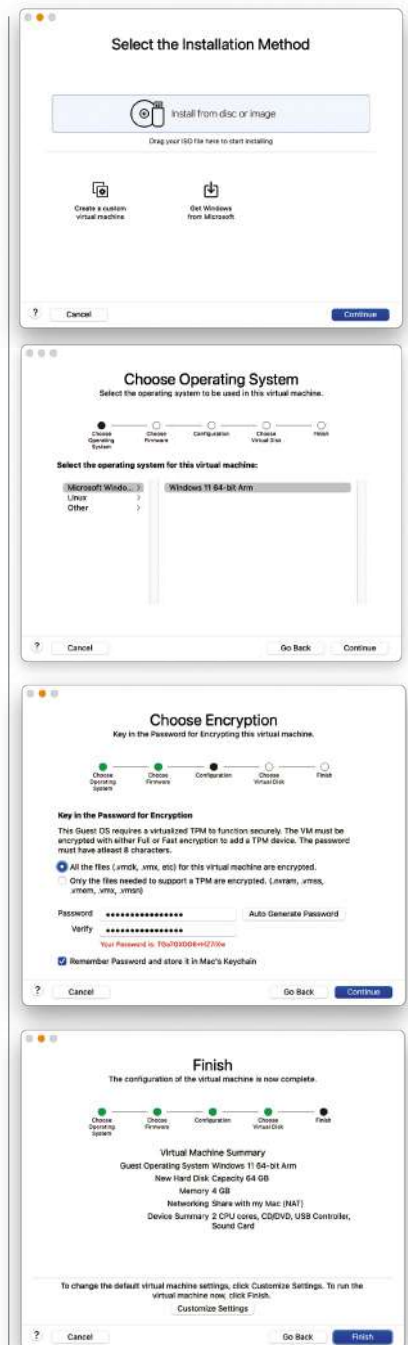
You can also tweak your VMware Fusion Player settings to suit your needs. Dragging the edges of the window will dynamically resize your Windows desktop; display scaling can either be adjusted natively in Windows, or in VMware’s System

**RIGHT** Open your converted image file, or download installation media from Microsoft

**RIGHT** VMware recognises your OS so you can click straight through

**RIGHT** You’ll need to set a password for TPM emulation

**RIGHT** Tweak the virtual hardware settings to suit your needs, or go with the defaults



Settings | Display page. At present there’s no way to set up native folder sharing between your Windows and Mac, but you can work around this by sharing folders via the network. The VM can be shut down, suspended or rebooted at any time via the Virtual Machine menu, and you can also instantly revert to a previous state via the Snapshots submenu.

For complete documentation on using VMware Fusion Player to run Windows 11 on Apple Silicon hardware, check out [pcpro.link/352fusion](https://pcpro.link/352fusion) – and you may also want to look over the unofficial guide at [pcpro.link/352guide](https://pcpro.link/352guide). ●

### What next for Windows on ARM?

The first ARM-based version of Windows was Windows RT, created in 2012 for the original Microsoft Surface tablet. It looked almost identical to Windows 8, but it only supported ARM-native code, and couldn’t run existing Windows desktop apps. Unsurprisingly, it flopped.

Thankfully, Microsoft learnt from that experience, adding an application translation framework to the ARM editions of Windows 10 and 11. Now that ARM PCs can run regular Windows software, the platform is finally working its way into the mainstream: Microsoft’s own Surface Pro 9 convertible is built on ARM silicon, as are a decent number of third-party Windows laptops.

Even so, ARM remains a second-class platform in the Windows world. The chips in those systems can’t match the speeds of the latest processors from AMD and Intel, and

running applications under translation doesn’t help with performance or power efficiency.

That could soon change, though. Qualcomm just announced its new generation of “Snapdragon X” ARM processors, promising to bring Mac-rivalling performance and battery life to the Windows platform in 2024. There’s more innovation and competition on the way, too, with both AMD and Nvidia reportedly working on rival ARM chips for release in 2025.

All of this means we can expect to see a lot more ARM-based PCs and laptops in the next few years – and as the market grows, developers will be increasingly incentivised to offer high-performance ARM-native versions of their applications. After more than a decade in the doldrums, it looks like Windows on ARM may finally get its chance to shine, and you can look forward to the benefits even if you’re running it on your Mac.

# Reviews

The biggest, best, most exciting products in technology – reviewed and rated

Looking for a particular past review?  
Visit our index at [pcpro.link/index](https://pcpro.link/index)

## Apple MacBook Pro (M3)

The M3 chips give the already brilliant MacBook Pro series a boost in games, with no sacrifices elsewhere



SCORE ★★★★★

PRICE As reviewed, £2,639 (£3,299 inc VAT) from [apple.com/uk](https://apple.com/uk)

**S**urprise! After Apple updated its MacBook Pro laptops with M2 Pro and M2 Max chips earlier this year (see issue 342, p48), we weren't expecting anything else new in 2023. But Apple always enjoys pulling something out of the bag (or envelope) and in this case that's a new colour and a trio of updated chips: the M3, M3 Pro and M3 Max.

The new colour, Space Black, is exclusive to the M3 Pro and Max models. That's true whether you buy

the 14in or 16in option. Otherwise, the design and dimensions are nigh on identical to what came before. That means a weight of around 1.6kg for the 14in laptop and a shade under 2.2kg for the 16in version.

The port selection is also identical, with three USB-C 4 ports supporting Thunderbolt 4, an SDXC memory card slot and a full-size HDMI port. If you buy the plain M3 version of the 14in MacBook Pro (the 16in MacBook Pro doesn't come with an M3 option), you get two rather than three USB-C ports.

### ■ Back to black

But enough about what's the same; I want to talk about what's different.

While Apple has done colourful and inspired finishes before, there's never been anything quite like the Space Black finish on the new MacBook Pro.

It's not just black – it's a light-swallowing black. I noticed this when trying to photograph the laptop, and watched as it devoured my studio lighting. The surface is just shy

**ABOVE** The M3 chip provides the grunt to match the classy Space Black finish



**"The performance of the M3 Max is stunning. I did my best to press this system but it shrugged off all tasks"**

**LEFT** Mini-LED technology means the MacBook Pro's display is still class-leading

of being matte black, and that low reflectivity prevents the light bouncing back at you. The new colour gives the laptop a bold, aggressive and no-nonsense look. Even gamers would be proud to take this laptop to their next tournament.

Apple has developed a new anodising process for the Space Black colour to create a fingerprint-resistant surface, and it repelled most of mine. That said, the sweatier the palm, the more visible the marks left on the laptop's surface, although even those fingerprints were faint. Just remember this is a fingerprint-resistant MacBook Pro, not a fingerprint-proof one.

### ■ More chips please

Then we come to the other big change: the chips inside (see "Need to know: Apple M3 family", overleaf). I like the way

Apple makes its chip series more powerful. It uses a standardised architecture, and then wraps more and more cores around it. The benefit is that all systems running the M3 SoC share the same impressive features, but some perform faster than others.

While the barebones M3 in the base model 14in MacBook Pro has an 8-core



CPU (four efficiency cores and four performance cores) and a 10-core GPU, the M3 Max chip in the machine I tested has a 16-core CPU and a 40-core GPU. According to Geekbench, the system is running at 4.1GHz (single core) and 3.3GHz (multicore).

The Geekbench 6.2 numbers were startling. Apple has taken pains to compare the base M3 to the three-year-old M1, but comparing an M2 MacBook Pro to the M3 Max is a real eye-opener (see the graphs, right). Granted, the M3 Max and the base M2 aren't directly comparable, but such a gulf in their results shows why you might pay so much for an M3 Max system stuffed with, in my case, 64GB of unified memory.

It's easy to forget that Apple silicon is running on the ARM-64 platform, and that not all macOS apps run natively on it. The reason I often forget this? Everything works. There's never been a moment in my three years of experience with Apple silicon where my MacBook throws up its digital hands and says, "Sorry, I can't run this app". Part of this is down to the rapid adoption of Apple silicon by developers, but it's also because the Rosetta 2 system (which translates between x86 code and Apple silicon) runs quietly in the background, managing all apps that are still looking for an x86 chip.

Still, the M3 MacBook Pro isn't perfect on the compatibility front. The x86-compatible Steam, which I used for most of my games, did crash. But weirdly, so did iMovie, repeatedly, and that's an ARM native. As did the ARM-friendly Adobe Photoshop 2024. At least the system as a whole never crashes; it doesn't even know the meaning of a blue screen.

This aside, the performance of the M3 Max is stunning. I did my best to press my test system but it shrugged off all tasks. I opened 40 or so browser tabs on both Safari and Chrome (normally a soul-crushing task for any system), launched Apple TV+, installed Steam, and then played *Tomb Raider Legacy*. I might as well have been composing something in Notes. I loaded up FinalCut Pro with 4K 30fps video as well as some 4K 24fps ProRes HDR content, and edited and manipulated them with ease.

While not visually evident, I think it's safe to assume that some of the system's speed and ease with these apps – often running concurrently – is the new Dynamic Caching technology. This is essentially a more efficient way of using available memory. Instead of X number of registers always being used for the same task, the system only applies the memory needed for each explicit task. The result is a lot less wasted

#### GEEKBENCH 6 (SINGLE CORE)

16in MacBook Pro (2023) M3 Max, 40-core GPU, 128GB	3,182
14in MacBook Pro (2023) M3, 10-core GPU, 8GB	3,100
16in MacBook Pro (2023) M3 Max, 40-core GPU, 48GB	3,078
16in MacBook Pro (2023) M2 Max, 38-core GPU, 96GB	2,686
14in MacBook Pro (2023) M2 Pro, 19-core GPU, 16GB	2,645
MacBook Air 15in (2023) M2, 16-core GPU, 16GB	2,574

HIGHER IS BETTER

#### GEEKBENCH 6 (MULTICORE)

16in MacBook Pro (2023) M3 Max, 40-core GPU, 128GB	21,564
16in MacBook Pro (2023) M3 Max, 40-core GPU, 48GB	20,863
16in MacBook Pro (2023) M2 Max, 38-core GPU, 96GB	14,626
14in MacBook Pro (2023) M2 Pro, 19-core GPU, 16GB	14,238
14in MacBook Pro (2023) M3, 10-core GPU, 8GB	11,870
MacBook Air 15in (2023) M2, 16-core GPU, 16GB	9,886

HIGHER IS BETTER

#### SHADOW OF THE TOMB RAIDER (1200P, FPS)

16in MacBook Pro (2023) M3 Max, 40-core GPU, 128GB	119
16in MacBook Pro (2023) M3 Max, 40-core GPU, 48GB	119
16in MacBook Pro (2023) M2 Max, 38-core GPU, 96GB	103
14in MacBook Pro (2023) M2 Pro, 19-core GPU, 16GB	57
14in MacBook Pro (2023) M3, 10-core GPU, 8GB	32
MacBook Air 15in (2023) M2, 16-core GPU, 16GB	26

HIGHER IS BETTER

#### BATTERY LIFE (WEB-SURFING TEST)

16in MacBook Pro (2023) M2 Max, 38-core GPU, 96GB	18hrs 56mins
16in MacBook Pro (2023) M3 Max, 40-core GPU, 48GB	18hrs 6mins
14in MacBook Pro (2023) M3, 10-core GPU, 8GB	17hrs 16mins
16in MacBook Pro (2023) M3 Max, 40-core GPU, 128GB	17hrs 12mins
MacBook Air 15in (2023) M2, 16-core GPU, 16GB	14hrs 48mins
14in MacBook Pro (2023) M2 Pro, 19-core GPU, 16GB	14hrs 23mins

HIGHER IS BETTER

memory and more left over for managing other critical tasks.

### ■ The gaming bug

Apple spent considerable time during its launch event telling us how it engineered the new M3 SoC with features specifically designed to handle graphics-intensive tasks such as AAA games. Hardware-based ray tracing and mesh shading might improve how your most expensive apps look, but we all know that it's really about gaming.

So, I played some games. First, a few hours of the eight-year-old but still engaging *Rise of the Tomb Raider*. It proved no challenge: gameplay was smooth even at the screen's native resolution of 3,024 x 1,964.

Next, I installed *Lies of P*, seemingly inspired by Pinocchio. It's a beautiful and atmospheric game that starts in a deserted train station. Everything is rendered in exquisite detail and, thanks to all the M3 Max's onboard graphics power, every surface looked about as real as it can in a game of this nature. Using Terminal for a real-time view of frame rates I found that, depending on the action, they bounced between 30fps and 60fps. Action looked smooth in most sequences, including fast-paced puppet-on-puppet battles.

I also played *Shadow of the Tomb Raider* at native resolution



**ABOVE** There's even more power beneath that familiar keyboard

and with every atmospheric element turned to the absolute highest. At times, the fans were so loud that they drowned out the game sounds, but the gameplay and graphics were all at their cinematic best, and in the game's benchmarks I achieved 108fps at 1,920 x 1,200 mode and 56fps at the highest, native resolution settings.

When I cranked *Total WarHammer III*'s settings to the max at 1,920 x 1,220 the fan churned on high and I saw object flickering. But the detail was all there, and the system reported a 56fps average. This dropped to 34fps at the MacBook Pro's native resolution.

It's clear that game developers are now thinking about the Mac as a viable platform, using the Game Porting Toolkit Apple released at WWDC 2023 to bring AAA games to the platform at the same time as on console. And now they're as immersive as anything on a Windows 11 gaming rig, albeit at markedly lower frame rates.

**BELOW** The MacBook Pro has three USB-C ports – unless you buy the plain M3 version





## Live long

Perhaps even more impressive is the chip's efficiency: the MacBook pumped out this level of performance even on battery power. While we run benchmarks with the laptop plugged in, I ran many of the same tests with it unplugged and saw a negligible difference. And, unless being pushed heavily, it performs all tasks in near silence.

Battery life is another benefit, although don't be lured by Apple's claim of 22-hour life. That's the promise for the 14in M3 model, but my more power-hungry M3 Max 14in MacBook Pro lasted for 18 hours at best. I saw that time when video streaming, but that figured dropped to 13 hours when browsing the web over Wi-Fi. And playing AAA games such as *Lies of P* for two hours saw battery life drop by 50%.

My average battery life has been roughly 12 hours of mixed use, which is a little bit less than I was expecting from this more efficient 3nm SoC. I do have some good news. Fast charging works as promised, and I topped up to 50% in 30 minutes using the included 96W charge adapter and the woven black USB-C to MagSafe cable that strikes a discordant note when plugged into the perfectly white adapter (I'm not sure why Apple didn't make that Space Black, too).

You can see how the different sizes and specs compare for battery life in the graph on the previous page.

## Game on

I haven't gone into details of the keyboard, webcam, speakers and screen of the new MacBooks as these

**ABOVE** The light-swallowing Space Black finish is unlike anything Apple has produced before

are identical to the previous iteration. By which I mean class-leading, with the mini-LED technology continuing to impress. In an ideal world Apple would have embraced Wi-Fi 7, but Wi-Fi 6E remains a strong choice.

It's without a doubt the best MacBook I've ever used, and finally gives Windows gaming laptops a run for their money. But it comes at a big price: the 15in M2 MacBook Air (see issue 347, p50) may well be a better option as it's thinner and lighter than even the 14in MacBook Pro.

So, as ever, it only makes financial sense to buy the MacBook Pro if you'll make full use of its capabilities. With this new generation, however, those capabilities are more remarkable than ever. And if you buy the Space Black version, you'll make one heck of an impression, no matter where you take it. **LANCE ULANOFF**

## SPECIFICATIONS

**MacBook Pro 14in:** M3, M3 Pro or Max chip • 8GB to 128GB unified memory • 512GB to 8TB M.2 PCI-E Gen4 SSD • 14.2in non-touch AMOLED display, 3,024 x 1,964 resolution • 72Wh battery • 313 x 221 x 15.5mm (WDH) • 1.6kg. **MacBook Pro 16in:** M3 Pro or M3 Max chip • 18GB to 128GB unified memory • 512GB to 8TB M.2 PCI-E Gen4 SSD • 16.2in non-touch AMOLED display, 3,456 x 2,234 resolution. 100Wh battery • 356 x 248 x 16.8mm (WDH) • 2.14kg to 2.16kg. **Shared:** Wi-Fi 6E • Bluetooth 5 • 3 x USB-C 4 ports with Thunderbolt 4 (2 x for M3 chip) • HDMI • SDXC card slot • 3.5mm headphone jack • MagSafe 4 charger • 1080p FaceTime HD webcam • macOS Ventura • 1yr RTB warranty

## Need to know: Apple M3 family

This month sees the full debut of Apple's M3 chips, not only in the updated MacBook Pro but also in the iMac we review on p52. We print their results on the previous page, but here we focus on what's changed compared to previous models.

The M3, M3 Pro and M3 Max chips are the first personal computer processors to use TSMC's 3nm process, compared to 5nm for the M2 family. The new chips also include an updated GPU that's better suited for video editing and gaming, as covered in more detail below.

The entry-level **M3** chip features 25 billion transistors. This chip has a 10-core GPU that's 65% faster than M1 for graphics performance, according to Apple. It features an 8-core CPU (four performance, four efficiency) and supports up to 24GB of unified memory.

Next is the **M3 Pro** chip, which has 37 billion transistors and an 18-core GPU that's up to 40% faster than the M1 Pro. This chip has a 12-core CPU (six performance, six efficiency) that Apple says can deliver up to 30% faster single-threaded performance than the M1 Pro. The M3 Pro supports up to 36GB of unified memory.

Lastly, we have the monstrous **M3 Max**. This contains 92 billion transistors, a 40-core GPU and a 16-core CPU (12 performance, four efficiency) that Apple claims is up to 80% faster than M1 Max. As if that wasn't impressive enough, this processor can support up to 128GB of unified memory.

All the new M3 chips have an enhanced Neural Engine meant to accelerate machine learning models. This Neural Engine is up to 60% faster than in the M1 series, says Apple. M3 processors also have an advanced media engine that provides hardware acceleration for video codecs such as H.264, HEVC, ProRes and ProRes RAW. The media engine also supports AV1 decoding, which is a first for a Mac.

## Enhanced graphics

The M3 lineup has an enhanced GPU containing a new feature called Dynamic Caching. This allocates the use of local memory in hardware in real-time, and uses only the exact amount of memory needed for specific tasks. Apple claims this feature is an industry first and, as we've seen in our tests, it significantly improves performance in both demanding applications and video games.

But it's not just about speed. Hardware-accelerated ray tracing makes its debut on Macs thanks to the M3 chips. And the new GPU also brings hardware-accelerated mesh shading to Macs for the first time. This means higher-quality graphics with more accurate lighting and detailed environments, as showcased at the launch event when Apple debuted an upcoming *Myst* remake. I could make out intricate shadows of a boat floating through the water as the camera panned out. The lighting effects bouncing off the wet dock were also realistic.

Finally, Apple says the M3 GPU delivers the same performance as M1 at half the power, and up to 65% more performance at its peak. **TONY POLANCO**



Starting prices	M3	M3 Pro (11/14-core)	M3 Pro (12/18-core)	M3 Max
14in MacBook Pro	£1,699	£2,099	£2,499	£3,299
16in MacBook Pro	N/A	N/A	£2,599	£3,599

\*Prices inc VAT from apple.com/uk

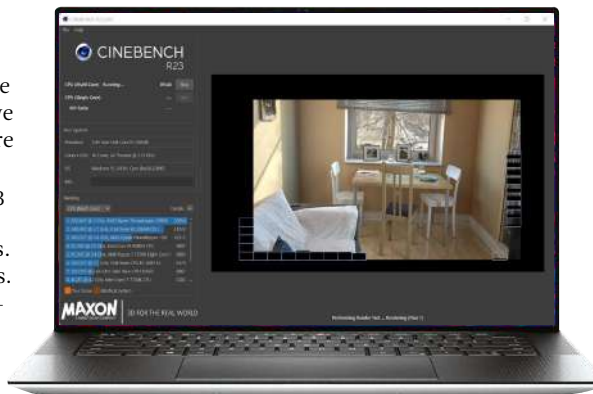
# How we test

## Laptops and PCs

We run a selection of benchmarks on all the PCs and laptops we test. Where possible, we use a cross-platform test so we can compare Windows and macOS machines, which is where both Geekbench and Cinebench R23 come into play. Both push the CPU to its limit, exposing how well cooled a system is.

We run extra tests for Windows systems. We use our own benchmarks to test photo-editing, video-encoding and multitasking speeds. We then switch to PCMark 10 to benchmark systems in office tasks, content creation and basic tasks such as web browsing and video calls. We also run 3DMark Time Spy and a selection of benchmarks in games such as *Metro Exodus* and *Shadow of the Tomb Raider*.

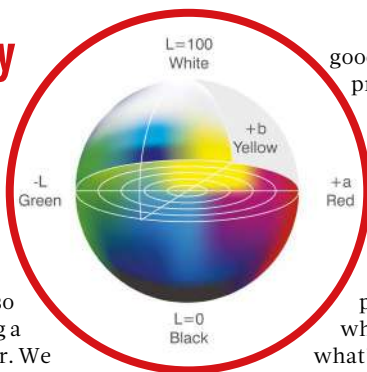
For laptops, we test battery life with Wi-Fi on and the screen brightness set to 150cd/m<sup>2</sup>. We fully charge the laptops and drain them until they reach 5%. For Windows laptops, we will use a mix of PCMark 10's light-use and video-based tests, or a web surfing benchmark where a laptop automatically visits sites until the battery dies. We also use this test for MacBooks.



**ABOVE** We put PCs and laptops through our intensive set of benchmarks

## Screen quality

In each laptop, phone, tablet and monitor review, you'll see our conclusions about the screen quality. Some of this will be subjective, but we also test each screen using a Display 11 colorimeter. We measure maximum brightness, colour accuracy and (for monitors) consistency – there may be a difference in, say,



good test of the processor and memory in particular, and include both a test for single-core and multicore performance. See below for a selection of scores to provide a reference of what's good... and what's not so good. We also run 3DMark Wild

Life test to give a measure of gaming performance.

As with laptops, we test phone and tablet battery life by playing a full-screen video until the battery runs out with the device. To simplify the test, we use Airplane mode. We set the brightness to as close to 150cd/m<sup>2</sup> as we can get in the device's settings.

**LEFT** We use a Display 11 colorimeter to measure sRGB gamut coverage and Delta E

**BELOW** We play a video with the screen set to 150cd/m<sup>2</sup> to test battery life



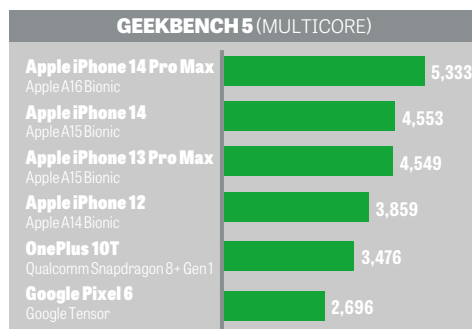
brightness from the middle and the edges of the panel.

We also measure Delta E, which is a guide to how accurately panels display colours.

Anything under 1 is excellent and likely to be difficult for the human eye to distinguish; between one and two is still strong; above this suggests a panel that you shouldn't trust for colour-accurate photo editing.

## Phones and tablets

We run a selection of publicly available benchmarks on all the phones and tablets we review. First, we run Geekbench 5 and 6. These are a



## What our awards mean



### Recommended

This, quite simply, is a product we recommend you buy – if it meets your needs.



### A-List

The best buy in its category right now. The product will also feature on our A-List, starting on p14. It's updated each month.



### Labs Winner

Each month we run a group test, or Labs. This product has managed to beat all others to top position.

## The pcpro.link

Throughout the magazine you'll see pcpro.link shortcuts. Enter these into the address bar of your browser and it will take you to a particular page, which will either be too long or awkward for us to publish or will take you to the precise shop from which to buy. If it's Amazon, note that we have an affiliate deal in place so we will receive a commission from each sale. This will never affect our verdict of a product, and if another reputable vendor is selling the product cheaper than we will use that instead.

## Prices will vary

Prices we publish are correct on the day we publish, but we often see prices change, especially on sites such as Amazon. However, we do work with British PC retailers to ensure the prices we quote for their systems are correct. If the price isn't being honoured, contact us via letters@pcpro.co.uk.

# The UK's most awarded workstations

Awarded PC Pro Workstation of the Year for the 8th year running



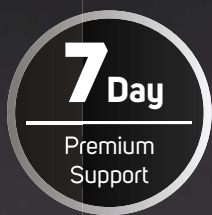
Find your perfect workstation today at:

[scan.co.uk/3xsgraphics](https://scan.co.uk/3xsgraphics) • 01204 47 47 47





 Windows 11



## 7 Days Support

Our engineers are available 7 days a week to help with any queries.



## 3-Year Premium Warranty

3XS workstations include a 3-year warranty, so if anything goes faulty we'll repair or replace it.



## Trusted by you

3XS workstations are rated Excellent and have won hundreds of awards in the media.

- ✓ Backed by 35 years of industry experience
- ✓ NVIDIA Elite Partner
- ✓ Five time winner of PC Pro's 'PC Manufacturer of the Year'

- ✓ 88-point QC check and 24-hour burn test
- ✓ Pre-configured and full bespoke systems
- ✓ Photo and video updates throughout your PC's journey

# SCAN

## Apple iMac 24in (2023)

Even speedier thanks to its M3 chip, and while the design stays the same there's still much to admire

**SCORE** ★★★★★

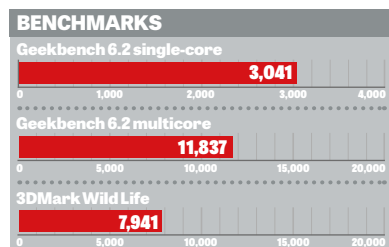
**PRICE** As reviewed, £2,333 (£2,799 inc VAT) from [apple.com/uk](https://apple.com/uk)

From looks alone, you'd be hard pressed to tell the 2023 iMac apart from its 2021 predecessor (see issue 322, p48). It comes in the same seven colours, has identical flaws (we'll come on to those) and costs roughly the same; the price at the top of this review is for the tested spec with 24GB of unified memory and a 2TB SSD, but the base unit with 8GB and 256GB costs £1,399.

What's new is the M3 chip inside. There are no M3 Pro or M3 Max options as in the MacBook Pro (see p46) – but beware that the cheapest version includes an 8-core rather than 10-core GPU. If you want the latter, you'll need to spend at least £1,599. The good news is that along with the pair of USB-C 4/Thunderbolt 4 ports found on the cheaper model, you get two USB-A ports, a gigabit Ethernet connector and Touch ID for the bundled Magic Keyboard. Apple's full colour palette becomes open to you, too, with the cheapest version solely available in blue, green, pink or silver.

Apple sent me the pink version to test, and it's still a novel experience to see such a colourful computer on my desk. The front of the unit is a pale and understated pink, while the rear is so saturated it may as well be red.

The rear is where you'll find everything you need to interact with the iMac M3. The power button and ports are all within (relatively) easy reach, and while you have to blindly grope around to find a port if you don't want to spin the display around, they're lined up in one row along the left side. You'll get used to finding your way around. What I can't get used to is a stand that lets you tilt the screen backward and forward a little, but won't let you adjust the height.



It looks stylish, but I'm 6ft 4in, and that means the only way I can use the iMac comfortably is to use a monitor stand or balance it precariously on the sturdiest books I can find. Or, at the time of ordering, select an iMac with a built-in VESA mount adapter.

The 24in 4.5K (4,480 x 2,520) display dominates the iMac M3, and it's as eye-catching and attractive as it was on the 2021 model. I enjoyed playing games and streaming films on the iMac M3 because it's bright and colourful; the vital stats are 508cd/m², 77% of the DCI-P3 gamut and an average Delta E of 0.2. However, it still doesn't support HDR or Dolby Vision, which is disappointing since those things are becoming more common in films, TV shows and games.

More games are now playable thanks to the M3, with 36fps in *Civilization VI* and 34fps in *Shadow of the Tomb Raider*. Those scores are with peak settings but at 1080p, so don't think of this as a gaming PC in disguise. Nevertheless, I did enjoy playing games on this iMac, which I can't say about the 2021 version.

**ABOVE** The 24in 4.5K display dominates the iMac M3, and it's just as eye-catching as ever



**"As an all-purpose PC, it's easy to recommend. It's fine for coding, photo and video editing, and a decent video converter, too"**

As an all-purpose PC, however, it's easy to recommend. It's fine for coding, photo and video editing, and a decent video converter, too: the M3 version completed our Handbrake test in 6mins 46secs compared to 13mins 38secs for the M1 model.

Apple again delivers for audio, with four woofers and two tweeters producing decent bass at loud volume. They even support Dolby Atmos and Apple's Spatial Audio, and the 3D effect is surprisingly effective for such a compact device.

It's similarly capable at performing mundane duties such as video calls, with the three-mic array capturing my voice clearly (though I wouldn't use it for podcasts) while the 1080p FaceTime camera in the centre of the top bezel performs well and benefits from the added processing boost provided by the M3.

It's still hard to give the 24in iMac a five-star review. Once you upgrade to 16GB of memory and a 512GB SSD, you're paying at least £1,799. Probably £1,999 for the faster, better-equipped version. And while you now get Wi-Fi 6E, Apple hasn't addressed some of the original design issues, particularly that fixed-height screen.

But if those flaws don't bother you, then you're buying a top-quality all-in-one computer that packs a delicious screen, plenty of power and a stylish design. **ALEX WARWO**

### SPECIFICATIONS

8-core Apple M3 with 10-core GPU • 24GB unified memory • 2TB SSD • 24in 60Hz IPS panel, 4,480 x 2,520 resolution • 2 x USB-C 4 with Thunderbolt 4 • 2 x USB-A 3.2 Gen 2 • gigabit Ethernet • Wi-Fi 6E • Bluetooth 5.3 • 1080p webcam • Magic Mouse • Magic Keyboard with Touch ID • macOS Sonoma • 547 x 147 x 461mm (WDH) • 4.5kg • 1yr RTB



**LEFT** The latest iMac comes in the same seven colours as the previous model

**biamp.**

**Amplify What Matters**



**Parlé**

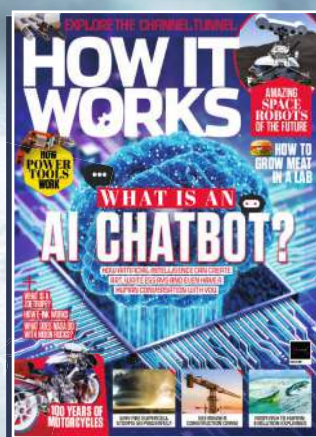
ALL-IN-ONE CONFERENCING BAR

**Learn more at [biamp.com/parlebar](https://biamp.com/parlebar)**

# Winter Savings

# SUBSCRIBE

# FROM JUST £6



PLUS OFFERS ON BINDERS, GUIDES & SPECIALS



See the entire range online at

**MAGAZINESDIRECT.COM/WINTER23**

or phone **0330 333 1113**

Outside of the UK? See our international offers online

Offer closes 31st December 2023. Offer open to new subscribers only. Direct Debit offer is available to UK subscribers only. We will notify you in advance of any price changes. All gift subscriptions will start with the first available issue on-sale after December 2023. If you would like your gift subscription to start with an earlier issue, you can choose an earlier issue when ordering or you can contact customer services. Orders purchased for yourself will start with the next available issue - please allow up to 6 weeks for delivery (up to 8 weeks outside of the UK). Payment is non-refundable after the 14 day cancellation period unless exceptional circumstances apply. For full terms and conditions, visit [www.magazinesdirect.com/terms](http://www.magazinesdirect.com/terms). For enquiries please call: +44 (0)330 333 1113. Lines are open Monday-Friday, 8:30am-7pm, and Saturday, 10am-3pm GMT (excluding Bank Holidays) or e-mail: [help@magazinesdirect.com](mailto:help@magazinesdirect.com). Calls from the UK to 0330 numbers will be charged at no more than a national landline call, and may be included in your phone provider's call bundle.

# Cyberpower Infinity X147 GRE Gaming PC

Intel's 14th generation Core i7 shows its power well in combination with a speedy AMD graphics card

SCORE ★★★★★

PRICE £1,666 (£1,999 inc VAT)  
from [pcpro.link/cyber352](https://pcpro.link/cyber352)

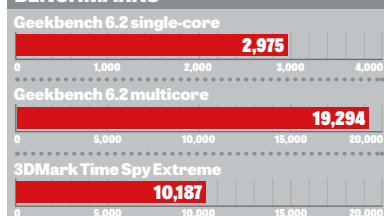
Although we think of gaming PCs as RGB monsters, am I alone in thinking they look best when lit in white? Especially so when you gaze into the innards of a powerhouse such as the Infinity X147 GRE and see braided matte black cables, Corsair Vengeance Black RAM and the looming black presence of AMD's RX 7900 GRE graphics card.

The GRE stands for Golden Rabbit Edition, and is only available to OEMs, but it might have been called an RX 7900 XT Lite. It has 80 rather than 84 ray-tracing units, 16GB of VRAM instead of 20GB (plus far less memory bandwidth), and a 2,245MHz boost clock to its brother's 2,400MHz. But it also costs less, giving system manufacturers a far cheaper option than the £800 RX 7900 XT.

The card is given every chance to shine thanks to Intel's Core i7-14700KF (see issue 351, p48), our pick of Intel's high-end lineup. We like it for eight high-performance cores, with a 5.6GHz boost for the strongest of them, while a dozen efficiency cores dispense with background tasks.

Cyberpower's choice of chip also means the AMD card will rarely be CPU-limited in games, and I was interested to see how it would cope at 1440p, this being AMD's target resolution for the GRE variant. The answer is storming. With all settings turned to the max, this machine averaged 165fps in *Shadow of the Tomb Raider*, 163fps in *Dirt 5* and 96fps in *F1 22*. Only *Metro Exodus Enhanced* proved a challenge, with 37fps at Extreme settings but a more than playable 60fps when I dropped down to Ultra.

## BENCHMARKS



PC PRO  
RECOMMENDED

This places the system almost squarely between one powered by a GeForce RTX 4070 and a RTX 4070 Ti; or, in AMD terms, faster than the RX 6800 XT but well below the speeds I'd expect from an RX 7900 XT.

There is 4K gaming potential here, but you may need to drop the graphic options. *Metro* only played happily at High (57fps), while *F1 22* dropped to 51fps at its punishing Ultra High settings. Switching to High, however, pushed that up to 183fps, and you'll have no trouble hitting three digits in *Shadow of the Tomb Raider* and *Dirt 5*.

Away from gaming, this PC devours everything before it. Not surprising

ABOVE Runs like lightning: plenty of power is on tap here

"The MSI motherboard is endowed with four M.2 slots. It's also superbly equipped when it comes to connectivity"

BELOW The large Lian Li chassis makes working inside easy



when you have 28 threads at your disposal: it raced through Cinebench R23's multicore benchmark with a score of 35,323, and fell just short of 20,000 in Geekbench 6.2. Cyberpower sensibly provides the 32GB of DDR5 memory across two 16GB DIMMs,

leaving two spare sockets if you want to double this. The final part of the recipe is Samsung's ever-speedy 990 Pro SSD, with this 2TB variant delivering superb sequential read and write rates: 7,064MB/sec and 6,732MB/sec respectively.

The only downside is that the components require lots of cooling to keep them performing at their peak, and even at idle there's plenty of fan noise. It grows louder when playing games, but it's never intolerable and that's the price you pay for high-performance gaming. There's an electrical cost, too, with an average 98W draw at idle and a top draw of 518W.

With an 850W power supply in place, that leaves plenty of room for upgrades. And you have lots of choice. The large Lian Li chassis makes working inside easy, while the MSI motherboard is endowed with four M.2 slots (plus RAID support). Two PCI-E slots lie empty – one is blocked by the graphics card – and there's room for two 3.5in hard disks and two 2.5in SATA drives if you remove the right-hand panel.

This is also a superbly equipped motherboard when it comes to connectivity. A 2.5GbE port sits at the rear along with eight USB-A ports, plus two USB-C ports, one of which supports USB 3.2 Gen 2x2. There's also a USB-C slot (Gen 2) at the top of the chassis, along with two USB-A 2 ports and a 3.5mm jack. The real audio treat is at the back, with support for 7.1 setups and an S/PDIF output. Even the wireless is fast, with Wi-Fi 6E and Bluetooth 5.3 provided.

In short, you're buying an awful lot for your money, including a five-year warranty – and bear in mind that Cyberpower won this year's Excellence awards for reliability and support (see issue 351, p26). **TIM DANTON**

## SPECIFICATIONS

20-core (8 P-cores, 12 E-cores) Intel Core i7-14700KF • MSI MAG Z790 Tomahawk WiFi motherboard • 32GB DDR5-4800 Corsair Vengeance Black RAM • 16GB AMD Radeon RX 7900 GRE graphics • CyberpowerPC Master Liquid Lite 360 ARGB AIO liquid cooler • 2TB Samsung 990 Pro PCI-E Gen 4 SSD • Lian Li Lancool 216 RGB chassis • 850W MSI MAG A850GL PSU • Windows 11 Home • 1yr Norton 360 Gamer • 235 x 480 x 491mm (WDH) • 2yr parts and labour C&R warranty (5yr labour-only RTB) • power: 98W idle, 518W peak



## Lenovo Legion Go

A handheld PC designed for gaming on the move and, while not perfect, it delivers for speed and quality

SCORE ★★★★★

PRICE £583 (£700 inc VAT)  
from lenovo.com

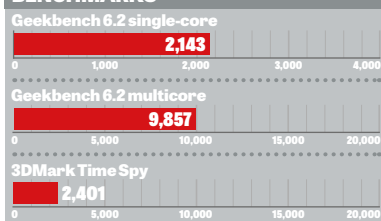
**T**he Lenovo Legion Go is an all-in-one handheld PC, aimed primarily at gamers. So why, you might ask, is it basking in a two-page review within *PC Pro*? The answer is that it has enough versatility to also serve as a general-purpose computing companion.

It's not the only such system out there. Asus released its ROG Ally earlier this year – see “Also consider”, opposite – and the Steam Deck remains a great choice if all you want to do is play games from your Steam library. Where the Go stands apart is that this is a slick and well-engineered device that I can genuinely imagine someone choosing to bring with them on a business trip rather than a laptop.

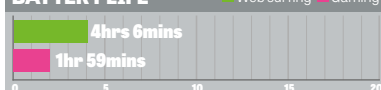
### Big is beautiful

The Legion Go is a sizeable thing, measuring 299mm from end to end and weighing a not insubstantial 854g. However, the chunky frame means there's room for a spacious 8.8in IPS display, and it's still lighter than almost any laptop. What's more – unlike the competition – the Legion Go has an integrated kickstand, so you can stand it up and play games, watch movies or use regular desktop apps for as long as you want, without having to hold the thing in your sweaty palms the whole time. It's a simple idea, but absolutely game-changing, and well implemented: the stand is reassuringly sturdy, with a wide and stable design that should stay put on any reasonably flat surface.

#### BENCHMARKS



#### BATTERY LIFE



The Legion Go's also includes two side controllers, which can be detached like Nintendo Switch Joy-Cons, allowing you to sit back and hold one in each hand. Unlike Switch controllers, these units don't contain motion sensors, but they're still astonishingly good. The design is admirably ergonomic, with high-quality padding in just the right places. The sticks use Hall effect sensors, which means you don't need to worry about drift, and an LED light ring around them provides a handy immediate indication of each controller's battery power and connection strength.

There's also a snap-on base that turns the right-hand controller into a sort of upright mouse, for extra precision in what Lenovo calls FPS mode. Plenty of other customisable buttons are scattered around the system, and even a touchpad; it can feel a little overwhelming, as if everywhere your fingers go they're in danger of inadvertently pressing something, but nothing activates unless you've assigned it a function.

### Sharp display, sharp speeds

Perhaps the star of the show is the Legion Go's gorgeous 8.8in IPS display. With a native resolution of 2,560 x 1,600 it's far more detailed than the Asus ROG Ally or Steam Deck, and a 144Hz refresh rate ensures motion is perfectly smooth. It also covers a surprisingly high 97% of the DCI-P3 colour gamut, with vivid and eye-catching colours. Naturally it's touch-sensitive, too, and I found it felt perfectly accurate and responsive when navigating the OS.

Indeed, the whole thing feels highly responsive, thanks to very powerful internals. The Legion Go is built on an eight-core

**ABOVE** The gorgeous 8.8in IPS display has a native resolution of 2,560 x 1,600



**“This is a slick and well-engineered device that I can imagine someone choosing to bring with them on a business trip”**

**BELOW** An integrated kickstand means you can stand it up and watch films

AMD Ryzen Z1 Extreme CPU, partnered with 16GB of LPDDR5 RAM and an integrated 12-core AMD RDNA GPU. This delivers strong benchmark scores: in Geekbench 6.2 we saw a single-core score of 2,143 and a multicore score of 9,857, which is impressively on a par with desktop PCs costing a similar amount.

This shouldn't be too surprising. The Z1 Extreme is a power-optimised version of AMD's Ryzen 7840U mobile chips, designed to run at 15W rather than 30W. That means it includes the same Radeon 780M graphics, complete with 12 cores.

### Gaming experience

The Legion Go's 3DMark results are less compelling than its productivity results, with a 6,451 return in Fire Strike and 2,401 in Time Spy.

However, in practice there's enough horsepower to handle even the most demanding AAA games. For example, one of the first things I tried on the Legion Go was *Forza Horizon 5*: even

with ray tracing turned on, I witnessed a smooth 51fps at full resolution with Medium detail settings. And to be clear, while Medium detail might sound like a compromise, it doesn't feel like one: I was blown away by how beautiful and detailed the car and environments were while racing. It really felt like I was gaming on a much bigger and more expensive system.

Audio quality was excellent as well, surprisingly so. The roar of the car's engine throbbed over the commentary, accompanied

by fast-paced music with such depth and clarity that I once again forgot that I was playing on a handheld.

I had equally good experiences with every game I tried, from less



demanding ones such as *Teenage Mutant Ninja Turtles: Shredder's Revenge* to top-tier titles such as *Baldur's Gate 3* and *Cyberpunk 2077*.

As well as offering impressive in-game performance, the portable device switches snappily between games, even ones from different PC storefronts. Loading can take a few moments, but the overall experience is very smooth, and even during extended gaming bouts I never noticed any heat-related stuttering or throttling.

## ■ Limited lives

On that point, although everything worked fine for me out of the box, you can switch between various thermal modes to achieve your preferred balance of performance and heat generation. The highest performance mode runs the fan at full blast, and is intended for use while the thing's plugged in, but there's nothing stopping you from using it in battery-powered mode: I found that even when the Legion Go was running flat out, it was never uncomfortably warm to hold.

Alternatively, if you want to eke out the longest possible battery life, you can switch to quiet mode, which runs the fan more slowly and throttles the hardware accordingly. You can define your own modes, too, if the presets don't quite suit you – or reduce your power demands by dialling down the graphical quality settings in your games. If you're investing in a high-end handheld gaming PC, however, you probably don't want to make the graphical compromises.

At any rate, even in maximum power-saving mode, the Legion Go inevitably provides only a couple of hours of gaming on a full battery, so you'll need to bring the charger with you when travelling. If you want to use the controllers in detached mode, they'll need to be charged, too: you can charge the whole system together, by ensuring they're connected when you plug in the main unit, but this will extend the charging time.

## ■ Beyond games

The Legion Go runs a full version of Windows 11 Home, with only a few Lenovo customisations to suit the format of the device. These include the Legion Space gaming front-end,

which notionally brings all the major gaming services together into one interface, but it's not particularly helpful, as you still have to download and log into each one manually before you can use it. It's a lot less streamlined than the Steam Deck's custom Linux-based OS, which is designed for quick and easy setup and access to your games.

The upside is that you can install any Windows software you like on the Legion Go, including full-fat productivity applications. The Go's



two USB-C connectors both support DisplayPort 1.4, so you can easily connect external displays and any other peripherals you might want to use, while Bluetooth 5.1 gives you easy wireless options for a keyboard and mouse.

At £700 inc VAT the Legion Go is notably more expensive than its two main rivals, the Asus ROG Ally and the Steam Deck. However, as well as powerful internals, that price gets you 512GB of fast NVMe storage – and you can add more capacity via a standard microSD card slot. A cheaper edition is planned, too, based on a regular AMD Z1 processor, which has six Zen 4 cores to the Extreme's eight.

In all, the Lenovo Legion Go is an impressive machine. It has great performance, a beautiful display, excellent controllers, crystal-clear audio and more. If you're looking for a more compact, cheaper system then the Steam Deck or ROG Ally are still worth a look, but if you're in search of the best handheld PC gaming experience, plus the option of

## SPECIFICATIONS

8-core/16-thread AMD Ryzen Z1 Extreme processor • AMD Radeon graphics • 16GB LPDDR5 RAM • 8.8in 144Hz IPS touch panel, 2,560 x 1,600 resolution • 512GB M.2 PCI-E Gen 4 SSD • Wi-Fi 6E • Bluetooth 5.3 • 2 x USB-C 4 • 3.5mm headphone jack • microSD card reader • 49Wh battery • Windows 11 Home • 299 x 131 x 40.7mm (WDH with controllers) • 854g • 1yr C&R warranty

## ALSO CONSIDER...

For handheld console gaming, the Nintendo Switch remains a hugely popular choice, selling more than 130 million units worldwide. You can buy it for £260 inc VAT from [currys.co.uk](https://www.currys.co.uk) – although it's been out for six years now, and it's rumoured that a follow-up console could be in the works for Christmas 2024.



## Asus ROG Ally

From £599 from [rog.asus.com](https://rog.asus.com)

If you prefer PC gaming, the Asus ROG Ally is a great little Windows 11 handheld. It has a gorgeous display, feels fantastic to hold and it provides you with access to your full PC gaming library.

Although performance isn't up to the level of the Lenovo Legion Go, it will handle modern titles at moderate-to-high frame rates, and it beats the Go on both price and compactness. Its major limitations are screen size – it has a 7in 1080p panel – and a battery life of less than two hours.

**ABOVE** The two side controllers can be detached, and one even acts as a mouse when placed in a base



**LEFT** The eight-core AMD Ryzen Z1 Extreme CPU delivers plenty of power

## Steam Deck

256GB, £349 from [store.steampowered.com](https://store.steampowered.com)

The Steam Deck is a cheaper option than the Asus ROG Ally, offering almost four hours of battery life. The custom SteamOS gives you slick access to your games, and while the 7in LCD panel doesn't match the technical specs of its rivals, games still look fantastic and run smoothly.

The upgraded Steam Deck OLED is out now, with prices starting at £479 (for the 512GB version), but if you simply want to play your Steam games on the go without spending a fortune then this handheld is a great deal.



# HP Dragonfly G4



A fantastic business laptop from its design to its battery life, and ideal for execs always on the move



**SCORE** ★★★★★

**PRICE** From £1,380 (£1,656 inc VAT) from hp.com

The perfect laptop may not exist, but the HP Dragonfly G4 comes close. It's a business laptop with style, with a lightweight yet robust design that makes it the ideal travel or commute companion, especially if you enjoy the attention of your fellow travellers.

I took it on a month-long trip around Europe, moving from one city to another, with the Dragonfly G4 squashed inside my backpack's laptop compartment. The premium-feeling outer shell, made of 90% recycled magnesium that helps keep its weight under 1kg, emerged without any scratches.

The HP's portable nature isn't based on weight alone. This 13in laptop's sleek design makes it much easier not only to carry around but

also to handle. It may not be quite as skinny as a tablet, but more than once I was reminded of using an iPad with a keyboard folio attached. It's that compact.

Pop it open and you'll notice that everything is perfectly centred – Wes Anderson would be proud. I despise laptops with a trackpad that sits more on the left to accommodate a number pad; I simply can't get used to it. Fortunately, I don't have to worry about that here. Even the speaker above the keyboard is nicely aligned.

The keyboard is comfortable and satisfying to type on. Despite keycaps on the smaller side because of the chassis' 297mm width, I didn't experience any missed or wrong presses during my time with it – and I clocked in more than 40 hours a week (honest, boss). The trackpad also feels high quality and responsive, with good, if not perfect, palm rejection.

Finally, there's a great selection of ports here, especially for a small laptop. The Dragonfly G4 comes with two USB-C 4 ports that also support Thunderbolt 4, one USB-A port with Power Delivery, an HDMI 2.1 output, a headphone/mic combo jack and a nano lock slot. All the ports I needed to stay productive on the move and

**ABOVE** The Dragonfly G4's design, spec and battery life make it an almost perfect laptop

when I found myself sitting at a desk. Although, if I'm being picky, there were times when I searched forlornly for a microSD slot.

## ■ Packing heat

There's always a downside to super-thin laptops and that's room for cooling. If you push this laptop for more than a minute, it will slow down compared to an identically

specified laptop with better cooling. That's exactly what we see when comparing the Dragonfly G4 with the Acer TravelMate P6 (see issue 350, p80), which shares the 16GB of

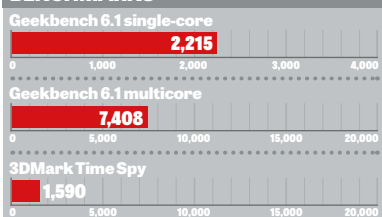
memory and Core i7-1365U of my test unit. Where the Acer hit 2,575 in Geekbench 6's single-core test, the HP managed only 2,215. And that gap grew still further in the multicore section, with 9,518 against 7,408.

While that gap is disappointing, coupled with the fact that fans are loud when pushed, in real-world use I never noticed a slowdown in my time with the G4. And I've had 25 tabs open on Chrome, several apps running, and been editing batches of high-resolution photos in Adobe

**"It may not be quite as skinny as a tablet, but more than once I was reminded of using an iPad with a keyboard folio attached"**

**BELOW** The selection of ports includes two USB-C 4 sockets that support Thunderbolt 4

## BENCHMARKS



## BATTERY LIFE



Photoshop at the same time. I can't recall a time when this laptop even struggled, including when I needed to export a dozen edited RAW images from Lightroom as JPEGs.

That's all while keeping things surprisingly cool – a noteworthy feat considering that slim chassis. It does get slightly warm, but not so much that you can't sit it on your legs when you're working on the sofa.

## ■ Spec savers

I wish that HP made it possible to buy exactly the specification I tested. In the UK, you can only have the Core i7-1365U in my machine with 32GB of RAM and a 1TB SSD, for a princely £1,800 (£2,160 inc VAT). That comes with the same 1,920 x 1,280 touchscreen as on my test laptop, and also includes support for 5G.

The cheapest version of the Dragonfly G4 loses 5G, drops the processor to a Core i5-1335U and halves the RAM to 16GB and the SSD to 512GB. You get the same 1280p touchscreen, though, and it costs £1,200 exc VAT (£1,440 inc VAT). Upgrading to a Core i7-1355U – which is almost identical to the 1365U, but with fractionally lower peak frequencies – ups the price to £1,380 (£1,656 inc VAT).

There is one final option, which is a version with a 3K (3,000 x 2,000) non-touch OLED panel. While we haven't tested this configuration, which only ships with 16GB of RAM, a 1TB SSD and the Core i7-1355U, you'll need exceptional eyesight to reap the rewards of that high resolution. I found that 1,920 x 1,280 pixels on a 13.5in panel to be more than sharp enough.

In fact, this display is an absolute stunner, hitting a brightness peak of 391cd/m<sup>2</sup> while offering 80% coverage of the DCI-P3 colour space (and almost 100% of sRGB). It's true that the OLED panel will provide better colour coverage, making it a wiser choice for those who intend to spend hours watching films (or editing them) on this laptop, but in general use you'll be more than happy with the colours produced here. You can trust their accuracy, too, with an average Delta E of 0.14.

It's harder to get excited by the speakers, with recessed mids meaning you can't enjoy the rich, full sounds you might hope for. However, the same can be said about the audio quality on most laptops, and it's more than adequate for video calls.

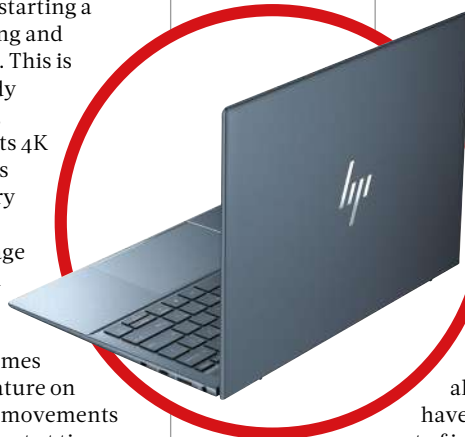
The Dragonfly G4 has some skills here, too. Selecting the Mixer feature in the myHP app lets you use the laptop's built-in webcam and a second webcam simultaneously, with the option to automatically switch

from one webcam view to another using face tracking. Auto switching isn't fast, but it otherwise works well and is useful if you have a multi-display setup. The app also offers a slew of tools, such as saving footage as a PDF, snapping stills, starting a livestream, auto framing and picture enhancements. This is where it comes in handy having a 5MP webcam, which not only supports 4K streaming but also adds extra sharpness to every image you capture.

The webcam's footage is clean and crisp, with good dynamic range so that the highlights aren't overblown. It comes with an anti-flicker feature on the myHP app, but the movements are still not the smoothest at times. Overall, though, the picture quality is excellent; just what you'd need for professional-looking footage during meetings with clients and colleagues.

One final word on software. As this is part of HP's business range of laptops, it includes Windows 11 Pro

**BELOW** The outer shell is made of 90% recycled magnesium and helps keep the laptop's weight under 1kg



**"The display is an absolute stunner, hitting a peak brightness of 391cd/m<sup>2</sup> and with 80% coverage of the DCI-P3 colour space"**



**ABOVE** The keyboard is comfortable to type on, and the trackpad feels responsive

and a year's subscription to its Wolf Pro security. This goes well beyond a typical antivirus package, tying in with the hardware to give you additional defences against attacks.

You also receive three years' of next-business day on-site cover, and this covers international travel to the 80 countries where HP has a support presence – yet another reason for frequent travellers to consider this laptop.

## ■ Battery boost

On the battery front, the HP Dragonfly G4 delivers exactly what professionals want from their work or business laptop. I was surprised the first couple of times I used it for work, as it lasted an entire work day and then some. That's partly thanks to Intel's power-efficient 13th

generation Core i7 U series chips, which consume little energy (their TDP is 15W) despite their turn of pace.

I've talked about how the Dragonfly G4 is the near-perfect laptop for professionals and business people who travel regularly for work, and its longevity only contributes to that. Travelling with it for a month around southern Europe and northern Africa was extremely convenient, as I only needed to charge it after a full day's work – at times, longer, depending on my usage. What's more, I could charge it overnight, use it on a long-haul flight or an all-day train ride, and never have to worry about running out of juice.

This is backed by our benchmarking, with the G4 lasting for an average of 12hrs 44mins across three tests. That isn't as long as the new 14in MacBook Pro with a plain M3, which kept going for 17hrs 23mins, but whatever your working day consists of you can safely assume that the G4 will keep going. Just be aware that if you choose the OLED version the battery life will likely drop by a couple of hours.

## ■ A flier?

The Dragonfly G4 has few faults. If I could, I would improve the sub-par speakers and add an SD card slot, but neither of those is a deal-breaker. Besides, HP needs to have something to work towards when designing the G5.

That near-perfection will cost you plenty of money, but that's true of the Dragonfly's rivals.

Anyone looking for a lightweight premium business laptop would be foolish to not at least consider the Lenovo ThinkPad X1 Carbon Gen 11 (see issue 350, p85), for example, which costs a similar amount but is available in far more configurations. However, it can't match the Dragonfly for eye-catching style. **MICHELLE RAE**

## SPECIFICATIONS

10-core (2 P-cores, 8 E-cores) Intel Core i7-1365U processor • Intel Iris Xe graphics • 16GB LPDDR5 RAM • 13.5in 60Hz IPS touch panel, 1,920 x 1,280 resolution • 512GB M.2 PCI-E Gen4 SSD • Wi-Fi 6E • Bluetooth 5.3 • 5MP IR webcam • HDMI 2.1 • 2 x Thunderbolt 4/USB-C 4 • USB-A 3.2 Gen 1 • 3.5mm headphone jack • 68Wh battery • 297 x 220 x 16.4mm (WDH) • 1kg • Windows 11 Pro • 1yr HP Wolf Pro Security Edition • 3yr on-site warranty

# Lenovo ThinkBook Plus Gen 4

An eye-catching laptop with a twistable screen – one side OLED, the other E Ink – but a high price counts against it

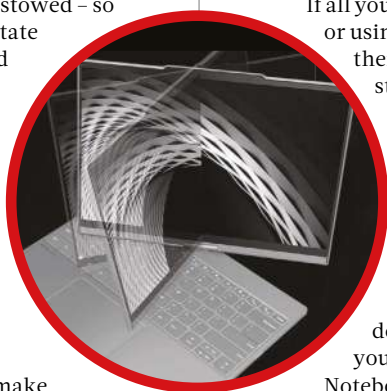
**SCORE** ★★★★★

**PRICE** \$3,039 from lenovo.com (UK pricing and availability to be confirmed)

**T**he Lenovo ThinkBook Plus Gen 4 is the most unusual laptop I've ever reviewed. Not only does it have a colour E Ink display on its lid, but it also features a hinge that lets you swivel the screen 180°. Note that isn't 360°, which is a shame – I kept trying to twist it in the wrong direction.

So, let's address the obvious question: why? According to Lenovo, it offers four modes: laptop, tablet, e-paper and typewriting. It also ships with a stylus – although sadly there's nowhere for it to be stowed – so you can write, annotate and draw on it. I find the Apple Pencil more enjoyable to write with thanks to its greater heft and girth, and while Lenovo's stylus is precise it's still no match for a real pen and paper.

The colour E Ink display is meant to make reading books and taking notes feel similar to performing the same acts on real paper. It can show anything the OLED panel can, so you aren't reduced to viewing content made specifically for e-readers. While a novel feature, I wouldn't recommend it due to the E Ink panel's low 12Hz refresh rate. Scrolling web



pages or documents is choppy, and a ghosting effect (when traces of a previous image remain on screen) adds to the annoyance.

Colours on the E Ink panel also look washed out at best, hitting 0.4% (that is not a typo!) of the DCI-P3 colour gamut. Still, it's better to have some colour than none at all.

If all you're doing is reading or using it as a typewriter, then the E Ink display still has its advantages. For a start, it's easier on the eyes, but it also cuts down on distractions. Switch on the Lenovo Reader mode and you can devour ebooks, while you can use Lenovo Notebook to scribble notes. If the performance is too sluggish, you can also use Reader and Notebook with the OLED display.

This 13.3in touchscreen panel is as vibrant as you would expect, covering 100% of the DCI-P3 gamut with an average Delta E of 0.21. It's bright, too, hitting 360cd/m² in our SDR tests and 480cd/m² with HDR content.

You can happily watch films on the ThinkBook Plus without headphones, thanks to clear audio and plenty of volume without distortion. Music

**ABOVE** With its 13.3in OLED screen in place, this looks like a typical laptop...

**"According to Lenovo, it offers four modes: laptop, tablet, e-paper and typewriting. It also ships with a stylus"**

**LEFT** ...but the hinged lid allows you to swivel the display by 180°...

**BELOW** ...to reveal a versatile 12.2in colour E Ink screen

lovers won't appreciate the lack of bass on offer, however.

Bearing in mind that Lenovo is pitching the ThinkBook Plus as a typewriter, it's a shame that it isn't part of the ThinkPad range with its deep key travel. Still, I found the keys snappy and responsive, and even though this is a compact laptop it never felt cramped when typing (and I have big hands). The trackpad's small footprint proved more challenging, not always registering my gestures.

While I say compact, I don't say light. At 1.4kg, this is substantially heavier than the streamlined 13in laptops we see elsewhere, with

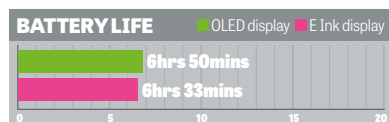
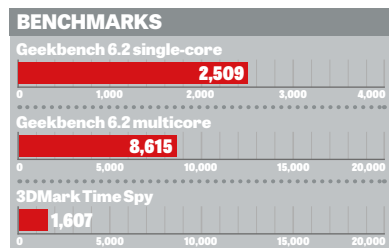
many now ducking under 1kg. What's more, they'll offer far better battery life than the Plus, which gave up after 6hrs 50mins of our web-surfing rundown test. That's poor.

Finally we come to speed, which is in line with expectations for a laptop with a Core i7-1355U. It's extremely fast for day-to-day operations, but those who use heavyweight apps or want to play AAA games should look elsewhere. Only one configuration is on sale, with 16GB of RAM and a 512GB SSD, which also restricts usage, but not as much as the fact that Lenovo UK hasn't announced a release date or price yet.

So, should you rush over to the US and spend \$3,039 on this machine? For the vast majority of people, the answer to that is a straightforward no. That's a shame, as I really wanted to love the Lenovo ThinkBook Plus Gen 4. After all, it's not every day you come across a 2-in-1 with a built-in colour E Ink display and a twistable hinge. As foldable phones have shown, having a device that serves multiple functions is advantageous. But while the idea behind this ThinkBook Plus sounds great on paper, it doesn't live up to the promise – especially for a device at this price. **TONY POLANCO**

## SPECIFICATIONS

10-core (2 P-cores, 8 E-cores) Intel Core i7-1355U processor • Intel Iris Xe graphics • 16GB LPDDR5 RAM • 13.3in 60Hz OLED touch panel, 2,080 x 1,800 resolution • 12in 12Hz Colorful E Ink touch panel, 2,560 x 1,600 resolution • 512GB M.2 PCI-E Gen4 SSD • Wi-Fi 6E • Bluetooth 5.1 • 1080p IR webcam • 2x Thunderbolt 4/USB-C 4 • 3.5mm headphone jack • 56Wh battery • Windows 11 Pro • 297 x 219 x 15.8-17.7mm (WDH) • 1.4kg • Lenovo Digital Pen 3 • 3yr C&R warranty



## IS TITANIUM



£499.99

CPU Intel Core i5 11400  
MOB ASUS PRIME H510M-A  
RAM 8GB DDR4 2666Mhz  
SSD 240GB Sata3 SSD  
HDD 1TB Sata3 HDD  
OPT 24x DVDRW Dual Layer  
GPU Intel Integrated HD630  
CAS Fractal Core 1100  
PSU 500W PSU  
O/S Windows 10/11 64Bit

## HELLFIRE



£999.99

CPU Intel Core i5 12400F  
MOB ASUS PRIME B660M-A WIFI D4  
RAM 16GB DDR4 3200Mhz  
SSD 1TB WD SN770 M.2 Gen 4  
GPU NVIDIA RTX3070 8GB  
CAS GAMEMAX F15M MESH  
PSU 750W Gold PSU  
O/S Windows 10/11 64Bit

## MERCURY



£599.99

CPU Intel Core i5 12400  
MOB ASUS PRIME B660M-A WIFI D4  
RAM 16GB DDR4 3200Mhz  
SSD 1TB Samsung 980 M.2  
GPU Intel Integrated HD730  
CAS KOLINK Stronghold  
PSU 500W PSU  
O/S Windows 10/11 64Bit

## COBRA



£399.99

CPU AMD Ryzen 5 5600G  
MOB ASUS PRIME A520M-K  
RAM 16GB DDR4 3200Mhz  
SSD 1TB Samsung 980 M.2  
GPU AMD Radeon Graphics  
CAS 1stPlayer D3-A  
PSU 500W PSU  
O/S Windows 10/11 64Bit

## AWARD WINNING PC SYSTEMS



From  
£79.99

## CPU MOTHERBOARD BUNDLES

DON'T YOU KNOW PALICOMP - YOU GOT TO PALICOMP





# 20 years

Best Broadband ISP as voted for by you!

It all started with 2 pints in 1 pub 28 years ago.

Fast forward to today and we'd like to say 1 huge...

# thank you.

Switch to Zen today ↻

 [zen.co.uk/broadband](https://zen.co.uk/broadband)

 01706 902954



## Dell Inspiron 14 2-in-1 (AMD, 2023)

It won't amaze you with premium build quality, but this is a solid convertible for an attractive price

SCORE ★★★★★

PRICE As reviewed, £441 (£529 inc VAT) from [dell.co.uk](https://www.dell.co.uk)

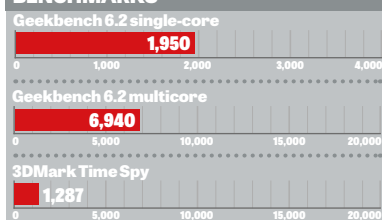
AMD's latest series of Ryzen mobile processors appear to be gaining traction with laptop manufacturers, with Dell choosing to update its Inspiron 14 convertible with a choice of Ryzen 5 7530U or Ryzen 7730U chips. This mirrors its Intel options (Core i5-1335U and i7-1355U) but with the advantage of costing £70 less.

I tested the Ryzen 5 option, which includes 8GB of RAM and a 512GB SSD, but if you upgrade to the Ryzen 7 (£649) those double to 16GB and 1TB. Note that you can upgrade the SSD yourself, but the RAM is integrated onto the board.

I didn't expect blistering speeds, but it held up well during my own use and in benchmarks. For example, I used the laptop during a normal workday and it didn't slow down even when I had more than 20 open tabs whilst running a YouTube video and Slack. And while Geekbench 6 scores of 1,950 and 6,940 are a long way from stunning, they show that this is a solid performer.

Those who value silence, however, won't appreciate that the Dell's fans can become loud after only a few minutes of use. Irritating when you're trying to concentrate on work.

### BENCHMARKS



### BATTERY LIFE



**ABOVE** The display effortlessly glides back when you want to use the laptop in tablet or tent mode

**LEFT** The keyboard is large with nicely spaced keys, but the deck has too much flex

With AMD's most basic Radeon graphics built in, the laptop's speeds in our gaming tests were mediocre. Sid Meier's undemanding *Civilization VI: Gathering Storm* averaged 25fps at 1200p, for instance, so if you want to play games then I suggest turning to Xbox Cloud Gaming or GeForce Now.

Nor would it be my go-to laptop for consuming films. There's nothing wrong with the detail across the 14in, 1,920 x 1,200 resolution screen, but colour reproduction is modest: 60% of the sRGB gamut, 43% of DCI-P3. Still, you can hardly expect vibrant colours from a budget laptop, and I

was impressed by an average Delta E of 0.2. Less impressive was a peak brightness of 234cd/m².

The two upward-facing speakers flanking the keyboard produce surprisingly loud audio. Podcasts or anything that mostly involves people talking sounds clear and sharp. The same applies when you're on a video call. However, they're not great for listening to music: mids and highs are fine, but there's next to no bass.

I also hoped for more from the 1080p webcam. Even in good lighting, images look blurry and washed out.

What about typing? The keycaps are large and spaced out nicely, but the keys feel mushy and the deck has too much flex for my liking. The smooth touchpad works well when you perform gestures, but that's offset by how hard you must press the touchpad when you want to left- or right-click. Sure, you can enable tap-to-click

in Windows so you don't have to click on the touchpad, but that's no excuse.

My mixed feelings extend to the Inspiron 14's design. It's a long way from ugly, but it is relatively thick and doesn't feel great to hold due to its mostly plastic chassis. Even the aluminium lid can't prevent the laptop from feeling cheap. At least the display effortlessly glides back when you want to use the laptop in tablet or tent mode.

And there are other factors that rescue it from two- or three-star ignominy. The first is the solid sprinkling of ports, with two USB-C, one USB-A, an HDMI output and an SD card reader.

**"Long battery life is another of the Inspiron 14's strongest attributes. It lasted for 11hrs 27mins in our web-surfing test"**

Long battery life is another of the Inspiron 14's strongest attributes. It lasted for 11hrs 27mins in our web-surfing test, so you probably won't need to bring the power supply with you

on day trips. A good thing as this convertible weighs 1.6kg.

All of which means that this laptop's main attraction is its price: if you're on a tight budget and you want a 2-in-1, then you'll struggle to find anything better. **TONY POLANCO**

### SPECIFICATIONS

6-core/12-thread AMD Ryzen 5 7530U processor • AMD Radeon graphics • 8GB LPDDR4 RAM • 14in 60Hz IPS touch panel, 1,920 x 1,200 resolution • 512GB M.2 PCI-E Gen4 SSD • Wi-Fi 6E • Bluetooth 5.2 • 1080p webcam • HDMI 1.4 • 2 x USB-C 3.2 Gen 2 • USB-A 3.2 Gen 1 • SD card reader • 3.5mm headphone jack • 54Wh battery • Windows 11 Home • 314 x 227 x 15.5-18.6mm (WDH) • 1.6kg • 1yr on-site hardware warranty

**BELOW** The solid selection of ports include two USB-C, one USB-A and HDMI



# Bag a software bargain

Don't pay full price for software when we can offer you huge reductions on everything from Norton 360 to Windows 11 Pro

## Upgrade to Windows 11 Pro for just £49.99

**SAVE 58%**



■ [pcpro.link/win11upgrade](https://pcpro.link/win11upgrade)

If you're using Windows 11 Home but fancy switching to Professional, we have great news. Not only is it a steal at £49.99, but it's incredibly simple to do. Upgrading is a matter of typing "Change product key" and then entering your new Pro licence key into the dialog box. Windows will then update, reboot, and you'll have a fully activated Windows 11 Pro.

Within minutes, you'll have access to extra business functionality: enhanced BitLocker encryption, remote logins and more. Perhaps best of all, you can create and host virtual machines using Hyper-V, which is ideal for testing new software or, if you're a developer, checking how your software performs on other OSes.

Windows 11 Pro also enables you to quickly connect to a domain – this could be your business or a school – to access network files, servers and printers. It's ideal for taking your work on the road when you still need access to the office network.

**ALSO CONSIDER** Windows 11 Home OEM licence for £59.99 **SAVE 50%**

## Norton 360 Premium for £19.99 (10 devices for two years)

■ [pcpro.link/norton360](https://pcpro.link/norton360)

We've negotiated a killer deal with Norton. No subscriptions, just a one-off bargain price of £19.99 compared to the regular £179.99 charge. That buys you two years of cover from the powerful Norton Security suite across ten devices.

And because it's the Premium version, you get a host of extra tools. There's 75GB of cloud storage for secure backups, plus the full version of Norton Secure VPN, both to protect your identity and provide a way of watching British TV while abroad.

Norton Parental Control provides tools to see exactly what your kids are up to on their various devices, and you also get GPS location monitoring for Android and iOS.

To round things off, Norton Password Manager generates and stores passwords across all your devices, while SafeCam for PC stops cybercriminals attempting to take photos with your webcam without your knowledge.



**SAVE 89%**

**ALSO CONSIDER** Avast Ultimate 2023 (10/2yrs) for £29.99 **SAVE 85%**

## Acronis Cyber Protect Home Office 2023 Advanced for £29.99 (1 device, 1 year, 50GB storage)

■ [pcpro.link/cyberprotect](https://pcpro.link/cyberprotect)

Acronis Cyber Protect has one simple aim: to protect your data from any threat. That means you get backup, disk cloning, cyber protection and privacy tools in a single package.

Advanced backup and disk cloning sit at this product's core. You get flexible backups, from full drive images to individual files, and clever incremental and differential options encourage daily backups without filling your storage. You also receive active disk cloning for migrating to faster or bigger hard drives. Perhaps most reassuringly, you benefit from Acronis' unique ransomware protection too.

The Advanced version packs in a whole heap of extra features, including antivirus and anti-malware to protect your computer and your backups.

The £29.99 price, a 23% saving over the full £38.99 cost, includes a one-device licence for either a PC or Mac with a one-year subscription and 50GB of cloud storage.



**SAVE 23%**

**ALSO CONSIDER** Adobe Photoshop Elements 2024 for £59.99 **SAVE 31%**

# Mobile Pixels Geminos

## An intriguing “stacked” monitor that works far better than you might imagine, albeit for a price

SCORE ★★★★★

PRICE £517 (£620 inc VAT)  
from scan.co.uk

Over the years, I’ve seen several bold ideas at big trade shows such as CES. Few of them ever see the light of the day, but full credit to US manufacturer Mobile Pixels ([mobilepixels.us](http://mobilepixels.us)): the Geminos display was nominated in the official CES 2023 innovation awards, and after a successful launch in the US it’s now on sale in the UK. As is the Mobile Pixels Deus Max (see p74), a second screen that piggybacks on a laptop.

While I’m yet to be convinced by that concept, the Geminos display is more compelling, especially for anyone with limited desk space. It’s the equivalent of extending into the loft rather than trying to buy the house next door, as this product is effectively two Full HD 24in monitors stacked atop one another.

They’re attached like Siamese twins, sharing the same mounting system. At one end of an extreme, you might have the bottom panel lying horizontal while the other faces you at right angles to its sibling. In general I used it with the bottom screen tilting towards me as shown in the photo, right. The hinge mechanism is smooth yet firm enough to stay in the position you want.

The screens operate independently of one another, with dedicated video inputs: USB-C or HDMI, so no DisplayPort. You can connect them to two different computers or use them as an extended desktop across a single machine. However, you’ll need two video outputs for the latter, so for most laptops that means connecting it via USB-C and HDMI, or using a port replicator and/or docking station.

I primarily used it like this, and soon found that my main work area gravitated to the bottom screen with reference materials at the top. There’s



no touch support, but I can still imagine video editors or professional coders enjoying this approach. I’m neither of those things, but I consistently found it useful when writing – and anyone who needs to write reports will do so too, I suspect.

While a widescreen monitor makes it easy to work on two windows side by side, your gaze is always dragged off to the left or right, because you’ll naturally have a main active window and a secondary reference window. Yes, Windows 10 and 11’s Snap feature makes it easier to manage multiple windows than previously, but I still found the top/bottom approach often works better.

One disadvantage – compared to a single widescreen monitor – is that there’s a centimetre-thick bezel between the two panels, so you lose a single-pane-of-glass view. I missed having a huge expanse of panel on several occasions.

The other negative is the panels’ limited Full HD resolution, which translates to 92 pixels per inch (ppi). That means jagged edges on text at typical viewing distances, and I consistently found myself wishing that Mobile Pixels had opted for 1440p panels instead. That would have

boosted the sharpness to 122ppi. You could also simply fit more into view, which is particularly useful for spreadsheets.

The panels themselves are decent quality but not professional standard. They cover 87% of the sRGB colour space and 64% of DCI-P3, but in use I found the colours strong. Colour accuracy is also fine, with an average Delta E of around 1.10 (less than 1 is ideal, but let’s not quibble) and a colour temperature of roughly 6950K. While I measured very slight variances, both panels are clearly from the same batch so colours always looked the same. Brightness peaked at 284cd/m², which is again fine, not brilliant.

All my measurements were using the monitor’s default sRGB setting, but you can switch to 5800K, 6500K, 7500K and 9300K using the basic OSDs. Each panel is controlled separately, but aside from changing brightness, saturation and contrast – and switching on

Eye Care mode – you have very little control compared to a typical monitor.

You should also temper any expectations for audio and webcam quality. The 1080p unit produces fuzzy results and muted colours that won’t embarrass you on a video call, but nor will you make a thrilling impact. The speakers are similarly uninspiring, with a tinny sound despite the opportunity to build bass into the meaty stand. This is where Mobile Pixels packs in the ports, with a separate USB-C input to keep it powered, two USB-A ports, a useful RJ-45 networking connector and two memory card slots: one for SD cards, one for microSD. Mobile Pixels sensibly puts the USB-A and card slots on the side so they’re easier to access, as this is a heavy unit that you won’t want to move about much once in place.

The final and obvious point to make concerns the price. You can pick up two similarly good-quality 27in 1440p monitors for around £250

each, yet here you’re paying £620 for two 24in Full HD screens. You need to be convinced that this setup works for you to make such an investment. **TIM DANTON**

**ABOVE** The pair of Full HD 24in screens work independently of one another

**LEFT** The screens can be angled to suit your way of working

**“You can connect them to two different computers or use them as an extended desktop across a single machine”**

### SPECIFICATIONS

2 x 24in 1,920 x 1,080 IPS panels up to 60Hz ● 6-bit+FRC panel (16.7 million colours) ● 14ms response time ● 2 x USB-C 3.2 Gen 2 ● 2 x HDMI 1.4 ● 2 x USB-A 3.2 Gen 1 ● microSD and SD card slots ● RJ-45 slot ● 1080p webcam ● stereo speakers ● 508 x 102 x 556mm (WDH) ● 10kg ● 2yr limited warranty

# Your bonus software

Total value  
this month  
**£214**

We scour the globe to negotiate the best software deals for our readers, from extended licences to full programs you don't need to pay a penny for. Here's this month's lineup

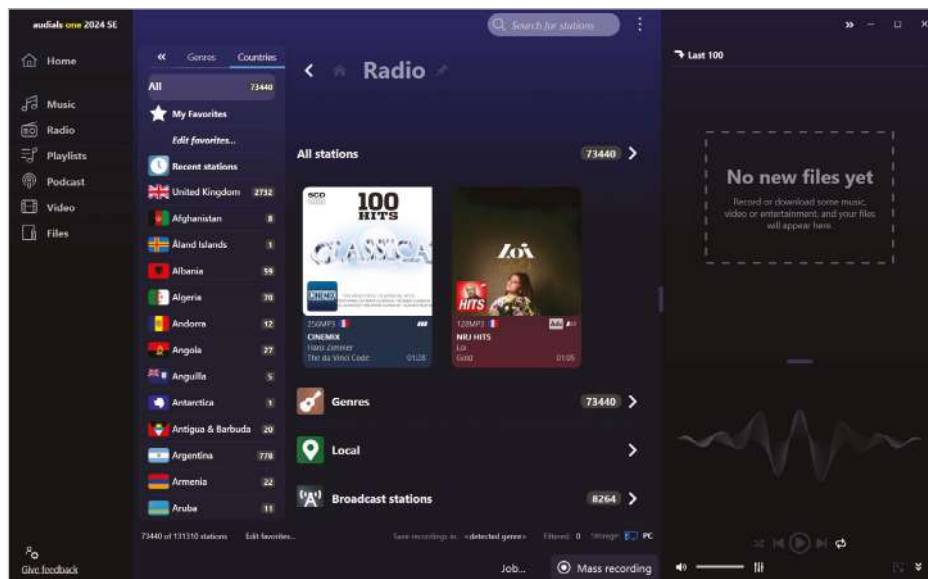
## Audials One SE 2024

With so many sites offering streaming video and music, finding what you want to watch or listen to can mean a lot of tiresome jumping from one site to another – unless you use Audials One 2024 SE. This is a one-stop shop for all of your streaming media needs, through which you can listen to music, podcasts and online radio stations, and watch TV and movies – all in one handy interface.

■ Full product worth **£30**  
■ **audials.com** **REQUIRES** Windows 10 or later; 1GB hard drive space; in-application registration

When you want to listen to a particular song, just search and Audials One will scour its catalogue of online resources to find it for you. You can also download tracks in MP3 format to keep them always available for offline listening. This is even possible with music videos – you can either download and save the complete video file, or extract the audio track.

Audials One also has some great features to help you grab large numbers of songs at once, too. For example, if you find a site that lists the best music by a particular artist, you can simply copy and paste its URL into Audials One; the app will then present you



with a list of all of the songs ready to listen to or download. You can also tell the program what music you're interested in downloading – such as a particular artist's back catalogue, for example – and it will search for and download it in the background.

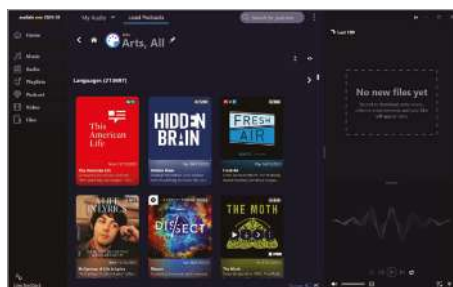
If streaming radio is more your thing, Audials One can help here, too. It provides a very simple way to access thousands of online radio stations from around the world, all fully searchable and organised by genre, so you'll always be able to find something to suit your mood. From there, you can build up a list of favourites and easily jump back to particular stations when you want.

In much the same way as you can download videos and music tracks, you can also record online radio stations, so you can listen to a favourite programme again in the future. Ads and presenter chat can be automatically snipped out, and any music you record will automatically have ID3 tags added for easy organisation and identification.

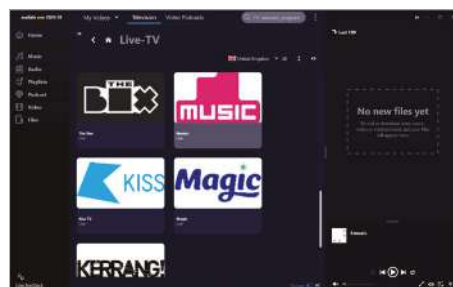
Podcast fans, meanwhile, can find and subscribe to podcasts from all over the world. With Audials One you can search by topic and browse existing episodes; new episodes of your favourite shows can be automatically downloaded as soon as they're posted, ready for you to listen to.



**ABOVE** Audials One includes a wealth of built-in search tools to help you find the music you want to hear using keywords



**ABOVE** You can also keep up to date with the latest episodes of your favourite podcasts, and find new ones inside the program



**ABOVE** Watch and record live TV channels, either by browsing or by directly adding web streams to your viewing schedule

## Excire Foto Light 2024

- Use the power of machine learning to organise your photo collection
- Speeds up the process of adding tags and metadata to your images, with automatic facial recognition
- Add your own keywords, manually apply star ratings and colour labels, and group photos into handy stacks and collections



■ Full product worth £69 ■ [excire.com](http://excire.com)  
REQUIRES Windows 10 or later; 1GB hard drive space; online registration

## Cleverprint 2023

- Save both ink and paper by printing several pages of a document on a single sheet
- Skip unwanted pages from print jobs to reduce waste – and suppress graphics to save ink
- Includes a PDF printer to convert any document to digital format and avoid using any ink or paper at all



■ Full product worth £30 ■ [abelsoft.net](http://abelsoft.net)  
REQUIRES Windows 7 or later; 150MB hard drive space; in-application registration

## Ascomp Synchredible 8



■ Full product worth £35 ■ [ascomp.de](http://ascomp.de)  
REQUIRES Windows 7 or later; 75MB hard drive space; in-application registration

- Synchronise folders and drives with no hassle
- Choose sync direction, specify actions for matching or missing files, and more
- Sync only recent updates to boost performance, or synchronise during Windows shutdown

## Iobit Advanced SystemCare 17 Pro



■ Six-month licence worth £10 ■ [iobit.com](http://iobit.com)  
REQUIRES Windows Vista or later; 50MB hard drive space; online registration

- Clean up, speed up and optimise your system, as well as perform security and privacy tasks
- Work manually, or task the program's built-in AI with taking care of business
- Purge personal data left behind by your browser

## AVG Internet Security 2024



■ One year of updates for one PC worth £41 ■ [avg.com](http://avg.com) ■ REQUIRES Windows 7 or later; 2GB hard drive space; online registration

- Real-time protection against zero-day malware courtesy of AVG's cloud-based smart scanner
- Optional passive mode runs alongside other security tools without conflict
- New secure DNS feature detects fake websites

## How to claim your bonus software

**1** Visit [pcprodownload.co.uk](http://pcprodownload.co.uk). First, enter the issue number (352 this month). Next, enter your email address and the coupon code printed on the cover's spine (or directly on the front cover of digital issues of the magazine). We'll then send an email to confirm that your code has been registered. Follow the instructions in the email to access the download area.

**2** Once you're in the download area, you can access this month's bonus software by navigating to the relevant product page and clicking the red Install button. For trial software, freeware and other downloads, click the Install button below the product description, or follow the onscreen instructions (please make sure to read these carefully).

**3** If the software needs registering, click the purple Register button, or follow the instructions on the left of the product page (again, please read these carefully). In some cases, you may need to register for a PC Pro software store account – if you don't already have one – and you might be prompted to reenter the coupon code on the spine or cover.

**4** Please be sure to install and register your bonus software before the date that's specified below. After this date, we can't guarantee that it will still be possible to download or register this issue's bonus software.

Remember to claim your software by 31 January 2024\*  
**[pcprodownload.co.uk](http://pcprodownload.co.uk)**

### Any problems?

If you need assistance with the coupon code or have registration issues, please contact us at [software@pcpro.co.uk](mailto:software@pcpro.co.uk)



# Amazon Eero Max 7

The first Wi-Fi 7 mesh is here – but don't buy yet, as compatible client devices are still a way off

SCORE ★★★★★

PRICE 2-pack, £958 (£1,150 inc VAT)  
from [pccpro.link/352eero](https://pccpro.link/352eero)

**N**ew technology klaxon! The Eero Max 7 is the first mesh we've seen – indeed the first router of any type – that works with Wi-Fi 7, also known as 802.11be. Yes, that's right: it's barely two years since we were welcoming Wi-Fi 6E as the latest and greatest wireless standard, but its successor is already here.

And to be fair, this is real next-generation stuff. Wi-Fi 6E was basically the same standard as Wi-Fi 6, merely extended into a new wireless frequency range. Wi-Fi 7 is a more fundamental upgrade, with features including a new ultra-fast 320MHz channel width on the 6GHz band and 4K-QAM encoding that packs more bits per second into the carrier signal.

The most exciting enhancement is MLO, short for multi-link operation. All previous Wi-Fi standards have required devices to connect on a single radio band, but with MLO, Wi-Fi 7 devices can now communicate simultaneously across the 2.4GHz, 5GHz and 6GHz bands. Not only does this massively increase the bandwidth available to each client, it should also mean more reliable and stable networks – because even if one band is affected by interference or a partially blocked signal, the other two will be there to keep up the connection.

## It costs how much?

As you might imagine, this cutting-edge technology comes with a considerable price tag. If you need to cover an area of 232m<sup>2</sup> or less, you can use a single Eero as a standalone router for a mere £600 inc VAT; a twin-pack covers up to 464m<sup>2</sup> for £1,150; while a three-unit bundle claims area coverage of up to 697m<sup>2</sup> for a rather stiff £1,700.

Faced with those prices, your first question is likely to be: is it really worth it? And the short answer is: not yet. For one thing, you almost certainly don't have a computer that's capable of taking advantage of Wi-Fi 7. A few manufacturers have announced high-end specialist laptops that support the new standard, but



mainstream systems aren't expected to appear until well into 2024, and I won't be surprised if it's 2025 before the technology is widespread.

Well, you might be thinking, at least I can take advantage of Wi-Fi 7 on my phone, right? It's true that a number of handsets are already arriving with early-adopter support for Wi-Fi 7, including the OnePlus Open (see issue 351, p60) and Google's new Pixel 8 phones (see issue 351, p70).

However, don't expect these compact, low-power devices to support the full speeds that Wi-Fi 7 is capable of. Using a Xiaomi 13T Pro smartphone, the fastest download speed I achieved over Wi-Fi 7 was 34MB/sec – slower than a typical Wi-Fi 6 link. If you want to see what Wi-Fi 7 is really capable of, you'll have to wait for more mature (and, most likely, more expensive) client hardware.

## Max 7 features

So, expectations thus managed, what can we say about the Eero Max 7 right now? It certainly feels like a heavyweight system. The upright stations are much larger and chunkier than previous Eero meshes; I found the new units ugly, especially with their high-gloss, white plastic casing, but they cram in a lot of technology, including 4x4 MIMO antennas on both the 5GHz and 6GHz bands. Round the back they offer the best Ethernet provision I've seen on any mesh: each station offers a pair of 2.5GbE ports and a pair of 10GbE ports, and they're

all auto-sensing, so you can choose which port to use for your internet line and which to save for local devices.

The software has distinctive features, too, though they won't be at all surprising if you've used an earlier Eero system. The whole mesh is controlled from the Eero smartphone app – there's no browser interface – which lets you monitor your network, check which clients are connected to

which stations, and perform basic administrative tasks such as adjusting Wi-Fi security settings and managing the guest network.

The Eero also ties into Amazon's existing home ecosystem. If you have a compatible Echo device then you can set that up as the Wi-Fi extender, and if you buy compatible IoT gadgets you can use Amazon's Frustration-Free Setup system to get them online without any interaction.

**ABOVE** The chunky Eero units cram a lot of tech inside their glossy plastic casing

**"If you want to see what Wi-Fi 7 is really capable of, you'll have to wait for more mature (and likely more expensive) client hardware"**

## For subscribers only...

Annoyingly, though, the real headline features require a paid "Eero Plus" subscription. Costing £100 inc VAT per year, this does include some

things you'd expect to pay money for: there's a VPN service provided by Guardian ([guardianapp.com](https://guardianapp.com)) with servers in 17 countries, network antivirus powered by Malwarebytes, and a family subscription to 1Password ([1password.com](https://1password.com)) bundled

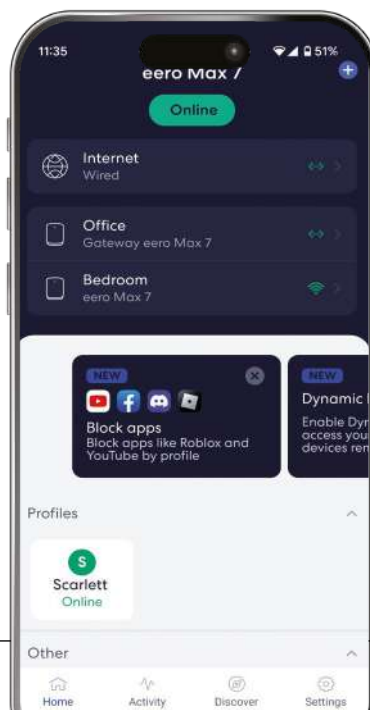
in with the deal. Parental control features are thrown in, too, with an impressive degree of control over which types of website and apps family members are allowed to access.

At the same time, it's galling to see more basic stuff such as Wi-Fi analytics, dynamic DNS and internet failover also rolled into Eero Plus. It doesn't cost Amazon a penny to provide these services, so it's a liberty to lock them behind a costly subscription – especially after you've paid so much for the mesh itself.

## Turn of speed

While the main point of the Eero Max 7 is obviously its

**BELOW** The Eero app lets you monitor your network and perform basic admin tasks



Downloads, MB/sec, 5GHz	Bathroom	Bedroom	Kitchen	Living room	Study
Asus ZenWiFi XD5	39	39	36	35	38
Mercusys Halo H80X	38	42	37	36	80
Amazon Eero Max 7	40	65	64	64	78
Linksys Velop Pro 6E	82	86	71	71	81
Netgear Orbi RBKE963	73	100	79	77	118
TP-Link Deco XE200	97	107	75	84	99

Uploads, MB/sec, 5GHz	Bathroom	Bedroom	Kitchen	Living room	Study
Asus ZenWiFi XD5	16	17	15	14	16
Mercusys Halo H80X	14	17	12	13	24
Amazon Eero Max 7	15	20	16	27	28
Linksys Velop Pro 6E	23	24	21	23	25
Netgear Orbi RBKE963	24	26	26	28	41
TP-Link Deco XE200	29	31	28	30	30

Wi-Fi 7 support, it will work perfectly well as a mesh system for your Wi-Fi 6 clients (and indeed older ones). Performance with legacy devices isn't bad at all: I tested this in my usual way, setting up a two-station mesh in my own home, then carting a laptop around the house, copying files to and from an Asustor AS3304T NAS attached to one of those multi-gigabit Ethernet ports and measuring upload and download speeds.

The tables above show the results I obtained, along with a selection of other mesh systems we've recently reviewed for comparison – two Wi-Fi 6 meshes, namely the Asus ZenWiFi XD5 and Mercusys Halo H80X, plus three 6E-capable systems from Linksys, Netgear and TP-Link.

The Eero Max 7 raced well ahead of the Wi-Fi 6 meshes, which is perhaps unsurprising since they both cost under £200 inc VAT. However, it couldn't quite match the performance of any of our Wi-Fi 6E systems. One factor here might be that, frustratingly, I couldn't get the Eero to use Wi-Fi 6E at all: every time my laptop tried to connect on the 6GHz radio band, the Eero quickly switched it over to a regular Wi-Fi 6 connection.

I suspect this happens because the Eero system doesn't have a dedicated backhaul radio, and is therefore trying to keep the 6GHz range clear for mesh traffic travelling

back and forth between stations. Whatever the explanation, there's unfortunately nothing you can do about it, as the Eero app doesn't give you any control over band splitting or steering.

If you want to get the best from your existing Wi-Fi 6E clients, therefore, the TP-Link Deco XE200 (see issue 349, p65) is a better option, costing £760 for two stations. And the Linksys Velop Pro 6E (see issue 350, p54) is a veritable bargain, with prices starting at £380 inc VAT for a two-node system.

### ■ The best is yet to come

Once I'm able to pair the Eero Max 7 with proper Wi-Fi 7-capable devices I expect to see transfer speeds beyond anything Wi-Fi 6E gear can deliver. But just how fast that will be is unclear: Amazon hasn't shared the full details of the Eero's radio capabilities, merely promising wireless connections at "up to

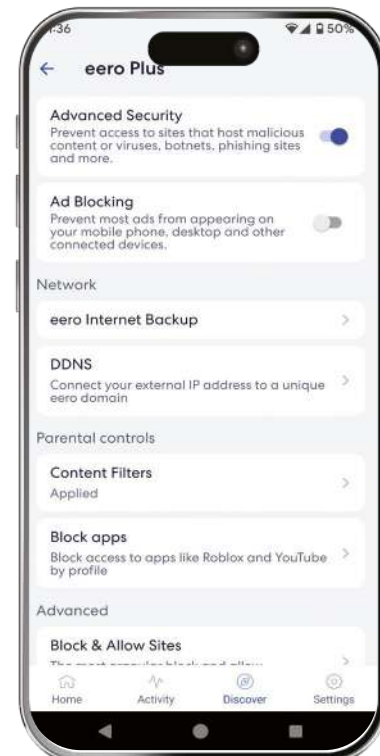
**ABOVE** Based on aggregate speed, the rows go from slowest (top row) to fastest

**RIGHT** Basics such as Wi-Fi analytics and dynamic DNS have to be paid for separately

**LEFT** Each station offers a pair of 2.5GbE ports and a pair of 10GbE ports

**"While Amazon wins the race to bring the first Wi-Fi 7 mesh to the UK, the achievement doesn't mean a whole lot right now"**

**BELOW** A three-unit Eero Max 7 bundle will set you back an eye-watering £1,700



4.3Gbits/sec". That suggests it won't get close to realising the full potential of Wi-Fi 7, which in theory could go as high as 46Gbits/sec. For comparison, the Netgear 970 mesh, expected to reach these shores in early 2024, claims top speeds of 5.8Gbits/sec on the 5GHz band, plus

11.5Gbits/sec on 6GHz.

So, while Amazon wins the race to bring the first Wi-Fi 7 mesh to the UK, the achievement doesn't mean a whole lot right now. There's nothing to be gained by buying the Eero Max 7 today rather than six months down the line, since almost no current hardware can take advantage of the new wireless standard. And by the time we're all toting our Wi-Fi 7 laptops around, the Eero will be facing competition from Netgear and others, and it remains to be seen how it will stack up.

No matter how excited you may be to try out the latest and greatest Wi-Fi technology, therefore, I'd suggest you hold fire, at least until you're using a Wi-Fi 7 laptop on a regular basis. In the meantime, maybe give those poor maligned Wi-Fi 6E devices a proper innings before they're fully eclipsed – as they certainly will be – by the next-generation standard.

**DARIEN GRAHAM-SMITH**

### SPECIFICATIONS

Tri-band 2.4GHz/5GHz/6GHz Wi-Fi 7 mesh ●  
10x spatial streams ● 2x 10GbE ● 2x 2.5GbE ●  
quad-core A73 processor ● 184 x 90 x 222mm (WDH) ● 45W external USB-C power supply ●  
1yr limited warranty





# Lenovo Legion Glasses

Solid specs in every sense, with great visual quality at the centre and two options for glasses wearers

SCORE ★★★★★

PRICE £358 (£430 inc VAT) from [lenovo.com](https://www.lenovo.com)

Lenovo announced the Legion Glasses at the same time as the Legion Go (see p56), arguing that they make a fine companion for anyone gaming on the move. Even if you're not interested in augmented reality (AR) features, you can simply as a virtual 86in display.

But that underplays what Lenovo achieves with its first pair of AR glasses aimed at consumers. For, much like the Ray-Ban glasses opposite, they look reasonably stylish, with heavy emphasis on "reasonably".

With their simple all-black frames, the Legion Glasses could almost be mistaken for regular sunglasses, except for the USB cable trailing down from the left arm, and the thickness of the "lenses" – in reality a pair of micro-OLED 1080p displays.

The assembly looks even chunkier if you snap in the corrective lens holder that's supplied in the box, but this allows you to adapt the Legion Glasses to your exact prescription. It's a neater approach than other AR glasses such as the Rokid Max AR, which offers myopia adjustment wheels for each eye. However, you'll need to pay to get your own lenses made up, which you might not be in a hurry to do after already paying £430 for the Legion Glasses. I was therefore pleased to see that Lenovo also includes a modified nose guard that allows you to wear the Legion Glasses on top of your regular eyewear.

This isn't a perfect solution. Lenovo warns that the bridge won't fit every pair of glasses, and I initially experienced some

awkwardness when trying to get the Legion Glasses to sit properly over my own spectacles. Once I'd found the sweet spot, though, the Lenovo Glasses stayed in place surprisingly well around my large frames.

I've no complaints about the build quality of the Legion Glasses. They're sturdy, yet light enough to wear for long periods without discomfort. When carrying the glasses around with me in various bags I never worried that they'd break in transit,

and their 96g weight is perfectly portable. Spare nose guards and a spare pair of anti-slip adapters are included, which is sensible: if accidents don't get you, wear and tear will.

The design is highly usable too, with two buttons in front of the speakers on each side. Long and short presses activate all the key features such as increasing or decreasing brightness, enabling Low Blue Light Mode, controlling volume and toggling the display off and on.

As for performance, the Lenovo Legion Glasses work exactly as promised. I spent about a week testing them extensively with a wide variety of devices, including

**ABOVE** The design is reasonably stylish for a pair of AR glasses

**"Perhaps because of their sharpness, I was able to use the Legion Glasses for as long as I wanted without any nausea or eye-strain"**

**LEFT** The corrective lens holder allows you to adapt the Glasses to your prescription

**BELOW** The superb image quality helps to make gaming totally immersive

watching videos on smartphones and playing games on laptops and PCs, as well as Lenovo's own Legion Go.

Although the Legion Glasses only officially support Android, iOS and Windows, I found they worked perfectly with the Steam Deck as well. The only limitation I ran into is that whatever device you want to connect, it must support a USB-C connection – an understandable restriction.

Image quality and brightness are superb. I tried the Glasses in a variety of lighting environments and had no problems: indeed, perhaps because of their sharpness

and responsiveness, I found I could use the Legion Glasses for as long as I wanted without any nausea or eye-strain – something I haven't been able to say for other AR or VR products in the past. They're not as hot and sweaty as the Rokid Max AR, either. My only real complaint is that the image sometimes blurred around the edges, especially if the glasses weren't seated perfectly on my head; on occasion, I had to pause and readjust them to get the best experience.

The little built-in speakers are excellent too – they sound so solid I forgot I wasn't gaming on a full-sized PC, and that great audio quality carries over to music and movie streaming.

The Lenovo Legion Glasses are too expensive to be an impulse buy, but they're on a par with competitors such as the Xreal Air AR (£339) and Rokid Max AR (\$299 plus import duties), and of course they're a mere fraction of the price of the upcoming Apple Vision Pro. They're still too chunky to pass as a "real" pair of fashion glasses, but no manufacturer has yet nailed that: for immersive gaming and multimedia the Legion Glasses are one of the best options around. **ALLISA JAMES**

## SPECIFICATIONS

1,920 x 1,080 60Hz OLED displays ● 2 x open-ear speakers ● USB-C 3.2 Gen 2 ● carrying case ● 155 x 79 x 50mm (WDH) ● 96g ● 1yr warranty ● OS independent



# Ray-Ban Meta Smart Glasses

A big improvement over the Ray-Ban Stories, but the AI is basic and you're limited to short videos

SCORE ★★★★★

PRICE £249 (£299 inc VAT) from meta.com

**T**hey're called Smart Glasses, but don't expect an immersive visual experience: these wearables have a built-in camera and speakers, but no display.

This means they don't suffer from the bulk of other smart headgear, such as the Lenovo Smart Glasses opposite. The Smart Glasses are just as stylish as a regular pair of Ray-Bans, and there are three frame types to choose from: Wayfarer, Wayfarer Large and the new Headliner style. Then pick a colour: matte or glossy black, or three transparent hues (black, blue or orange). You can also choose from clear, shaded, polarised, photochromic or prescription glass, giving you more than 150 possible ways to express your personal look.

Whichever combination you opt for, the Smart Glasses are as light and easy to wear as regular glasses, with all variations weighing in at around 50g. That's not bad considering they include a four-hour battery, stereo speakers and 32GB of storage, plus an IPX4 water-resistance rating.

Using the Smart Glasses, however, is a mixed experience. Having a camera integrated directly into your eyewear feels wonderfully freeing: you can capture the world about you, with a voice command or a quick tap on the frame, without interrupting the flow of whatever you're doing.

Unfortunately, the camera has only a 12MP sensor, which doesn't capture as much detail as a typical smartphone camera, and composing pictures is hard because there's no viewfinder. If you just want a quick image of your general surroundings then

you should be fine, but I frequently struggled to get the shot I wanted.

Video works better. The Smart Glasses record decent footage at 1080p, providing a fun, easy way to capture experiences while still feeling present in the moment. Automatic image stabilisation compensates well for moderate head movements, and the five built-in mics pick up nearby voices and music with pleasing clarity. A bright light on the side of the glasses lets people around you know that they're being recorded.

The video experience has its own limitations, however. Local recordings are limited to a maximum of one minute, after which the recording simply cuts off; that's fine if you're making clips for TikTok, but it really limits your ability to capture lived experiences. And while you can get around the time limit by live-streaming, the only supported destination platforms are Facebook or Instagram.

As well as shooting stills and videos, the Ray-Ban Meta Smart Glasses can be used as headphones. Podcasts and vocal performances sound rich and clear, and the open-ear design means you can listen without being cut off from the world. (The flipside, of course, is that passers-by can overhear your audio if you're playing it at a moderate volume.) Sadly, the bass response is terrible. The Smart Glasses impart very little low-end oomph, which means much modern music feels weak and empty.

The last major feature of the Smart Glasses is Meta AI – basically the

**ABOVE** The glasses can shoot stills and video, and can also output audio

firm's version of Alexa or the Google Assistant. Voice commands worked well enough for simple tasks such as taking photos or making phone calls, but when I tried to use the glasses to send messages on Facebook Messenger, the AI had trouble working out which of my hundreds of contacts I wanted to talk to, and I quickly gave up.

**"Meta AI has conversational capabilities, enabling it to answer questions on the go or provide comments about photos you've taken"**

Meta AI also has conversational capabilities, enabling it to answer questions on the go or provide comments and suggestions about photos you've taken. However, this feature is currently only live in the US, with no word on a UK release. And the most impressive Meta AI feature isn't available anywhere in the world as yet: at some point the Ray-Ban Meta Smart

Glasses will supposedly gain the ability to scan what you can see and answer questions about the scene or object you're looking at, but we'll have to wait and see how well that works.

One thing that I unequivocally love about the Smart Glasses is the charging case. It looks practically identical to a classic Ray-Ban case, but can provide a whopping 32 hours of charge – enough to keep your glasses topped up for days or weeks on end.

Even so, it's hard to recommend spending £300 on the Ray-Ban Meta Smart Glasses (and more if you want prescription lenses). They're not short on style, but almost every feature comes with some sort of limitation, and the Meta AI experience is particularly rudimentary for UK users. **HAMISH HECTOR**

## SPECIFICATIONS

12MP camera • 3,024 x 4,032 photos • 1,440 x 1,920 videos at 30fps • 2 x open-ear speakers • 5-mic array • 32GB flash storage • Wi-Fi 6 • Bluetooth 5.3 • charging case • 147 x 49mm (WH) • 49g • 2yr warranty • compatible with Android 8.1 and iOS 13 and above

**LEFT** The stylish Smart Glasses are as light and easy to wear as regular specs



**ABOVE** The integrated 12MP camera is liberating, but photos lack detail



## Amazon Echo Show 8 (3rd generation)

A huge upgrade, with better audio, faster performance and added smart home support

**SCORE** ★★★★★

**PRICE** £125 (£150 inc VAT)  
from amazon.co.uk

**T**he third-generation Amazon Echo Show 8 looks a lot like the 2021 model, but it brings a ton of improvements that make it the best Echo Show yet – and arguably the best Echo device, full stop.

When I say it looks like the previous version, that's not exactly a compliment. The 8in 1,280 x 800 display remains crisp and clean, with excellent brightness, but the thick bezels are starting to feel dated. Still, the front now has sleek edge-to-edge glass, and the sides and rear have been slimmed down, too. It feels robust, and is made from 29% recycled materials – so it's not as green as, say, Apple's latest devices, but it's getting there.

Another change is that the camera has been moved from the right side of the frame to the centre, which works better for video calls. It uses the same 13MP sensor as the previous model; despite this high resolution, images don't look particularly crisp, but it's fine for informal video calls or security footage. As before, the auto-framing feature pans and zooms to keep you centred in the frame, based on your proximity and position. I'm impressed by how well this works, although if you're moving about while talking it can be a tad slow to follow. For those who are uncomfortable about having a camera inside their home, the physical camera shutter is still there, along with soft buttons to disable the microphone and adjust the volume.

Then again, if you keep the camera active, you can take advantage of a new feature called Visual ID. This lets the Show learn what you look like, then personalise its responses and the information displayed on the screen, based on who's standing in front of it. It's as if each member of

your household has their own personal assistant. I also like the new Adaptive Content feature, which adjusts the display according to how far away you are from the device (so, detailed info when you're up close, more at-a-glance updates when you're more distant).

Perhaps the biggest upgrade to the Show 8 is a new eight-core SoC, which includes Amazon's AZ2 Neural Network Engine. Amazon claims this delivers a 40% speed improvement over its predecessor, and I can confirm that the Echo Show 8 is easily the fastest Show device I've used.

The touchscreen felt beautifully responsive, and Alexa always responded promptly, whether I was asking her to turn on my smart lights, call a friend for a video chat or translate words and phrases into a foreign language. The Show even pulled up a movie from Amazon Prime Video within a couple of seconds – a task that could take my last-gen Echo Show 5 as long as a minute.

Another internal enhancement is to the audio system. Just like the second-generation Show 8, the new model has 2in neodymium stereo speakers with a passive bass radiator, but the hardware that drives them has been upgraded, now including support for spatial audio and acoustic room sensing, which tailors the sound to suit the environment. The effect is impressive, with clear highs

**ABOVE** The Echo Show 8's 1,280 x 800 display is crisp and clean



**LEFT** A physical shutter lets you turn off the camera

**"Amazon claims its AZ2 Neural Network Engine delivers a 40% speed improvement over its predecessor"**

**BELOW** The upgraded sound system produces highly impressive audio



and a solid bass response. I wouldn't call it an audiophile experience, but it's better than the massive soundbar I have in my living room, and it goes loud enough to comfortably accompany your next party.

A final upgrade is improved smart-home capabilities; as well as existing "Works with Alexa" devices, the Echo Show 8 can now manage Matter, Thread and Zigbee devices.

All of these enhancements have a big collective effect. Thanks to the improved speed, smarts and sound of the new Echo Show 8, I found myself much more eager to throw on a TV show while cooking in my kitchen, or to stick on Taylor Swift while doing the dishes. Video calls to friends and family feel less like a game of hide-and-seek, and it's good to know that I don't need to worry about controlling any future smart home devices I buy.

The only thing that holds back the Echo Show 8 is its price. Where the old model cost £120 inc VAT, the new one pushes that up to £150. If you want units for the kitchen, bedroom and living room, it gets expensive quickly. Then again, Amazon does offer frequent discounts on its own-brand devices, and there's also a compact 5in model costing £90 that does many of the same things.

With its generous screen and excellent audio, however, I think the new Show 8 is worth the asking price. It's a slick, well-made device that goes far beyond the capabilities of a conventional smart speaker.

**MICHELLE RAE UY**

### SPECIFICATIONS

8-core SoC with Amazon AZ2 neural network engine • 8in 1,280 x 800 touchscreen • dual 2in stereo speakers • 4-microphone array • 13MP camera • Wi-Fi 5 • Bluetooth (A2DP and AVRCP) • Matter, Thread and Zigbee support • 200 x 106 x 139mm (WDH) • 1kg • 1yr limited warranty



**TE14 SERIES**

## IMMERSIVE COLLABORATION FOR EDUCATION AND ENTERPRISE

Today's students are tomorrow's professionals – helping to shape industry, science and progress. Our teachers and leaders demand high performance, reliability and flexibility.

The **TE14 SERIES** from iiyama empowers all education, training and presentation environments to seamlessly deliver engaging content, collaborative tools and thanks to our hybrid solution deck of Android 13 and OPS Slot PC features, you can be sure that no matter what your Interactive aspiration, iiyama has the simplified solution just for you.

The new Multi-Screen Display feature allows you to link multiple screens and run as many different applications as you need for dual and triple display integration in large spaces like lecture amphitheatres and large meeting/boardrooms.

The high quality built-in 8 Array Microphone and Dual Directional Speakers support conferencing configurations and our 500Hz Frame Rate Touch sensor delivers the smoothest and fastest Touch response ever seen with added Touch features like Dual Palm Rejection and Anti-Bacterial Pens for safety in multiple user environments.

With sizes from **65"**, **75"** and **86"** everyone will benefit from the flexibility and clarity that the **TE14 SERIES** delivers.

**TE14 SERIES**

## PRODUCTS INTERACTIVE LARGE FORMAT DISPLAYS

**ProLite TE6514MIS-B1AG**

**ProLite TE7514MIS-B1AG**

**ProLite TE8614MIS-B1AG**

Discover the full range  
of the iiyama **TE14 SERIES**





## Mobile Pixels Duex Max

An interesting idea that's well implemented, but it's a bulky and expensive solution to a niche problem

SCORE ★★☆☆

PRICE £242 (£290 inc VAT) from scan.co.uk

**M**obile Pixels' Geminos (see p65) aims to double the screen space of a desktop PC, and its Duex Max wants to achieve the same feat for your laptop. The trick is that it attaches to laptop lids using four round magnets – think chunkier versions of CR232 batteries – which are kept in place with strong adhesive stickers. You can remove them, but only 12 stickers are included in the box.

With the magnets fixed (a two-minute procedure), you can attach and detach the Duex Max at will. It includes two strips of metal that the magnets hook onto, so you simply slot it into position. Once the Max is in place, you pull the screen out from its built-in sliding mechanism, using the hinge to angle the monitor as shown



**ABOVE** The Duex Max slots into a metal strip on your laptop's lid

**BELOW** You can use it as a second monitor, but it's designed to work in portrait mode



this provides both power and a signal. The supplied cable is long enough to stretch to the opposite side of your laptop if that's where the USB ports are.

The panel itself is typical quality for a portable monitor, so not great. It covers 55% of the sRGB gamut with an average Delta E of 4.91, with its highlight being a peak brightness of 286cd/m<sup>2</sup>. You can make very basic OSD adjustments using three buttons at its rear.

I commend Mobile Pixels' ingenuity for bringing the Duex Max to market, and there may well be a niche it fills. But it's overpriced at £300 (a flash sale on the brand's US site dropped the price to \$180), while the need to keep those four magnets attached – not exactly an attractive sight on a laptop lid – mean that you may end up preferring to use it as a plain secondary monitor, albeit in the portrait mode dictated by the hinge's design. **TIM DANTON**

### SPECIFICATIONS

14.1in 1,920 x 1,080 IPS panel up to 60Hz • 6-bit (262,000) colours • 30ms response time • USB-C • mini-HDMI • 320 x 226 x 14.7mm (WDH) • 859g • 1yr limited warranty

## Cherry KC 200 MX

This affordable mechanical keyboard is stripped down in terms of features but not in terms of quality

SCORE ★★★★★

PRICE £67 (£80 inc VAT) from box.co.uk

**I**f you say the words “mechanical keyboard” to most people, I suspect they'll think of a gaming keyboard. Usually costing three figures, coming in eye-searing designs and packing so much RGB they need a mini power substation to keep running. The Cherry KC 200 MX is an extremely welcome alternative, with this wired keyboard coming in an understated bronze finish with minimal lights – white LED indicators for numlock, caps lock and scroll lock are your lot – and an attractive £80 price.

That buys you keys with the latest Cherry MX2A Brown switches, with 4mm of travel, no “clack” noise and a lifetime of 100 million hits per key. Gamers aren't entirely forgotten, as the keys support anti-ghosting (so all

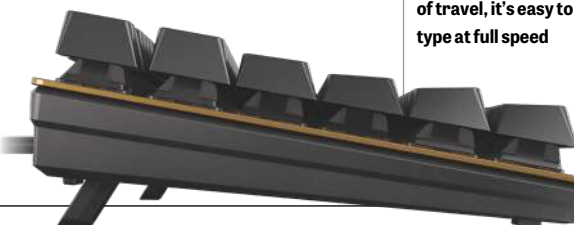
key presses are registered, even if you hit several at the same time) and N-key rollover. I found I could hit my maximum word rate per minute with few problems, and was soon reminded why there isn't anything quite like a mechanical keyboard if you want to bash out words at pace.

The keys feature a 2mm pre-travel, but I still found it oversensitive at times. I lost count of how many times I accidentally brushed the F11 key when I was aiming for the Backspace, sending Edge into full-screen mode. The key layout is flawless, but “media” keys are restricted to volume up,

**ABOVE** The KC 200 MX has a more subtle design than most mechanical keyboards



**BELOW** With 4mm of travel, it's easy to type at full speed



down and mute. These three sit above the number pad, along with a Calculator shortcut. You can download the Cherry Keys software if you want to, say, assign shortcuts or macros to the function keys.

While I tested the Cherry MX2A Brown version, there is a MX2A Silent Red option (G80-3950LHBGB-2) that's more geared towards gamers due to the keys' shorter travel and quicker actuation. Both keyboards cost £80, and bearing in mind the three-year warranty, top build quality and thoroughly enjoyable typing action, I would consider that money well invested. **TIM DANTON**

### SPECIFICATIONS

Wired mechanical keyboard • Cherry MX Brown switches • integrated 1.2m USB-A cable • 430 x 121 x 39mm (WDH) • 830g • 3yr warranty • part code G80-3950LHBGB-2

## Obsbot Tiny 2

This portable webcam delivers for quality, design and sharpness, but sadly it has a price to match

SCORE ★★★★★

PRICE £274 (£329 inc VAT)  
from amazon.co.uk

**T**his is no ordinary webcam. Touting an elegant, lightweight and pocket-friendly design, the Obsbot Tiny 2 is sculpted from a magnesium alloy that feels luxurious to the touch. No expense has been spared here.

Obsbot provides a robust case to protect it on the move, which makes sense as the camera is mounted on a gimbal; you wouldn't want anything heavy breaking it off the axis. It comes with a magnetic mount for your monitor – the webcam snaps on and off in a fraction of a second, perfect for frequent travellers – while you can buy extra accessories such as a tripod (a mount is on its underside), remote control (£59) and even a mic.

But where the Obsbot Tiny 2 really shines is its long list of features. It recognises three gestures that can trigger the camera's zoom, dynamic zoom and subject tracking. All three work incredibly well – better than with the previous version seen with the Obsbot Tiny 4K (see issue 332, p73) – but you'll need to practise before you get those gestures down pat.

The Tiny 2 also comes with voice control, with nine commands that do things such as wake the webcam, put it to sleep, adjust the zoom, turn subject tracking on and off, and switch from one preset position to another. This, too, works beautifully, and there's no need to raise your voice for the webcam to hear your commands.

These features can be used without the Obsbot app, but downloading this gives you greater control over settings and adds further modes. Beauty Mode, for instance, only works via the Virtual Camera setting in the app; you then select the "virtual camera" option as the



**ABOVE** Obsbot Tiny 2: a premium webcam at a premium price

**BELOW** The Tiny 2 can be controlled by voice or gestures



webcam in your video calling software of choice.

Video quality is likely to be a big step up from your current webcam, especially at 4K and if you activate PixGain HDR: this captures two images simultaneously and combines them to reduce motion blur and add crispness. Quality isn't perfect, however, with overblown highlights and dark shadows if your lighting is uneven. You can adjust exposure in the app, but who wants to fiddle with that? In addition,

autofocus is sometimes sluggish and the microphone distorted my voice, making it sound harsh. Hopefully, that's fixable in an update.

Despite those criticisms, this is a fantastic webcam that will likely be improved yet further with updates. The big hurdle is obvious: the price.

**MICHELLE RAE UY**

### SPECIFICATIONS

- 50MP 1/1.5in CMOS sensor • f/1.9 aperture • 4K streaming at 30fps • 1080p streaming at 60fps • 86° field of view • 4x digital zoom • HDR • 2-axis gimbal (300° pan, 180° tilt) • USB-C connector • 47 x 44 x 62mm (WDH) • 96g • 1yr limited warranty

**ZYXEL**  
NETWORKS

**Powerful.  
Secure.  
Wireless.**  
22Gbps WiFi 7



WBE660S Enterprise-class WiFi 7 Access Point  
Find out more at [zyxel.com](https://zyxel.com) or call 0118 912 1700



# Luxury TABLETS

Tablets arrived with a bang and then seemed to whimper away, with only the iPad standing strong. But now they're back in a variety of guises

**I**s it time for a tablet renaissance? After the initial explosion of devices in the wake of the Apple iPad's launch back in 2010, tablets rapidly went out of fashion. Amazon carved out a niche for its family-friendly Kindle Fires geared towards content consumption, but only Samsung has shown greater ambitions.

Now things are changing. The iPad Pro and iPad Air have proven there's a strong case for creativity and productivity on tablets, while Lenovo and Samsung have both launched big-screen tablets designed to show that Android can do this stuff as well.

This year's Tablet Labs includes great premium devices you can use to watch blockbuster shows and movies or plan your next holiday online. And we still have plenty of budget-friendly offerings.

But we've focused on tablets that can handle more demanding applications. That could be working on the move, creating podcasts, editing photos and videos – and from anywhere you choose.

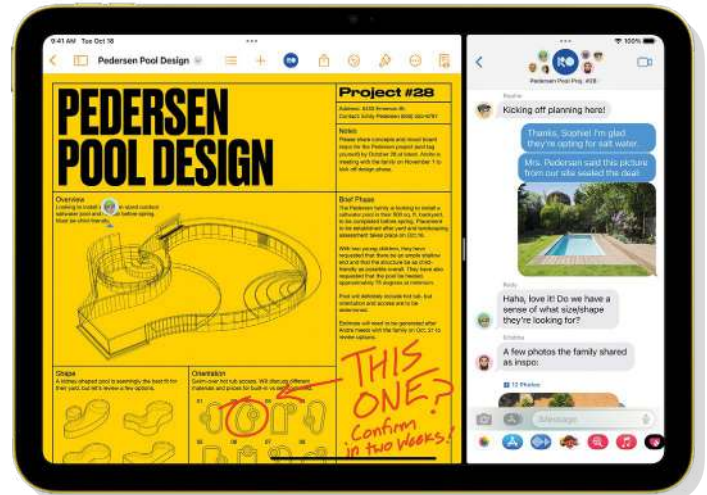
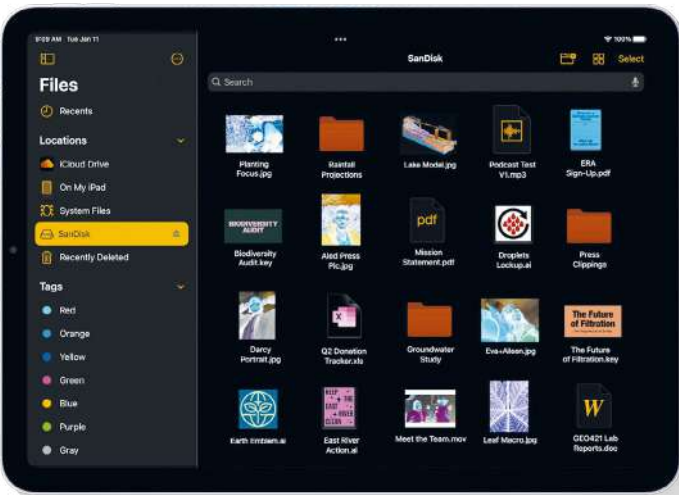
We hope you find a tablet that's not just for Christmas, but that could make a real difference to the way you live and work.

**CONTRIBUTOR: Stuart Andrews**

## CONTENTS

Amazon Fire Max 11 .....	82
Apple iPad (10th generation) .....	83
Apple iPad Pro 12.9 (6th generation) ....	84
Lenovo Tab P12 .....	85
OnePlus Pad .....	86
Samsung Galaxy Tab S9 Ultra .....	87
Apple iPad Air (5th generation) .....	88
Google Pixel Tablet .....	88
Honor Pad 8 .....	89
Honor Pad X9 .....	89
Lenovo Tab Extreme .....	90
Samsung Galaxy Tab S9 .....	90
TCL NXTpaper 11 .....	91
How to beat the tablet-buying blues .....	78
Feature table .....	80
Gaming on tablets .....	91
How we test .....	92
Graphs .....	92
View from the Labs .....	93





# How to beat the tablet-buying blues

It's worth spending a few minutes thinking carefully about what you want from a tablet, as it could save you a lot of money in the longer term

**Y**ou might think it doesn't need saying, but buying a tablet is not like purchasing any other type of computer – or even like buying a new phone. Purchase a new laptop and you're buying a standardised device that fits into a well-established ecosystem. Your "Windows experience" won't differ greatly from one laptop to another, and the same is true if you're a MacBook fan. You'll have access to the same hardware accessories and software choices whether you spend £500 or £5,000.

Tablets are different. The screen and ergonomics can transform the way your slate works and handles. The software may support multitasking and a wide range of creative and productivity applications, or it may focus more on content consumption. Some tablets have accessories that make them significantly more flexible and useful. With others, you'll be lucky to find a case that fits. If you don't factor all of this into your decision, you could make a choice you later regret.

## ■ It's all about the screen

We can't say this enough: the screen defines the tablet, including how you can use it, how it's going to feel and work in your hands, and how useful it's going to be for productivity and creative apps – or simply bingeing Netflix while in bed.

Size and resolution are key. Go too big, and you may have a tablet you find less portable or manageable, but go too small and you'll find it hard to work effectively, particularly when it comes to multitasking. Meanwhile,



**ABOVE** A keyboard can transform your tablet into a versatile productivity tool

**We can't say this enough: the screen defines the tablet, including how you can use it, and how useful it's going to be**

opting for a higher resolution – 1600p or above rather than the basic Full HD 1080p – will give you a crisper image and smoother text, which can often compensate for a slightly smaller screen size.

Beyond that, look for brightness and colour depth. The brighter the tablet, the easier it will be to use in a range of different situations, and the better the experience

when watching video or editing images. The higher the colour depth, as indicated by its coverage of the sRGB and DCI-P3 colour gamuts, the richer and more natural the image is going to be, particularly if those colours are accurate as well.

OLED screens almost always have an advantage over IPS panels when it comes to colour gamut coverage. To the point where if you see the word OLED (or AMOLED, or Super AMOLED; they're all variations on a theme) then you can be confident of rich colours and superb blacks in particular.

Don't write off IPS screens, though. These can also produce stunning results, and if you examine our graphs on p93 you'll see some tablets with IPS panels that produce excellent colour coverage and accuracy.

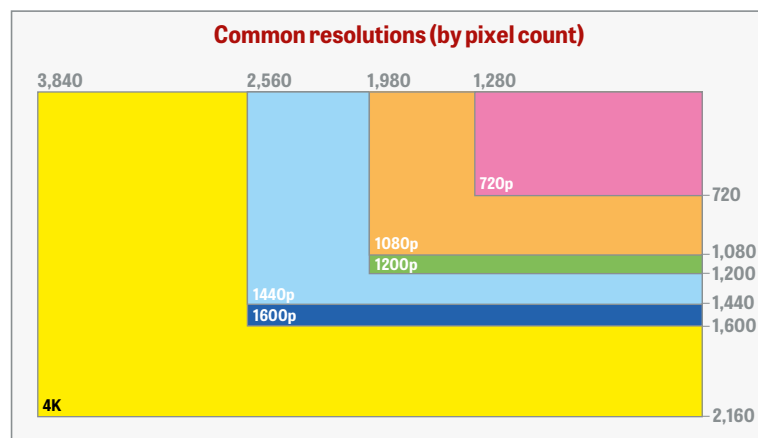
## ■ Buy for comfort and resilience

Screen size is the most important bit, but weight, materials and design also have an impact. Slimmer and lighter is usually better, but curves and grippable surfaces can also make a tablet much easier to use. All-metal and/or unibody constructions are now the norm, but plastics can be just as resilient, as anyone who's seen a toddler abuse a cheap Amazon Fire tablet can tell you.

## ■ Get the speed you need

Performance isn't critical if you're mainly browsing the web, participating in video calls or watching films, but it's crucial if you're planning to do creative work, run productivity apps or play games. Opt for models with faster processors and 4GB or more of RAM – and preferably 6GB or more.

How fast is fast? The Apple M1 and M2 processors in the new iPad Air and Pro models set the pace, but you can get strong results from the fast Qualcomm Snapdragon or MediaTek



Dimensity chipsets. We've done extensive benchmarking across all of this month's tablets to help you make your choice (see p92).

## Software counts

Don't underestimate the impact software will have on how you use your tablet. Apple again leads the way here, not just in terms of how effective and feature-rich its iPadOS software is, but also in terms of the range and excellence of the tablet-specific software available for iPad. It's still the best choice for creative apps and games.

Android continues to suffer from a lack of serious applications designed for tablets, and it's hugely irritating when forced to use apps designed originally for phones, which make no real use of a larger tablet screen.

What's more, the variations on Android that tablet manufacturers install vary dramatically in terms of features and usability. In particular, multitasking and multi-window support will work very differently from tablet to tablet. Samsung and Lenovo know what they're doing, but don't assume that everybody does.

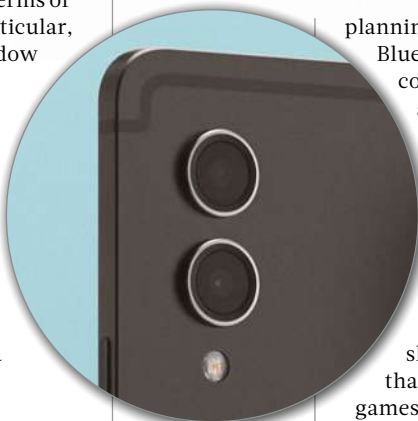
## Cameras and connectivity

The received wisdom is that anyone who uses a tablet as a camera is a selfish, irritating mug – and here the received wisdom is absolutely right. However, cameras are a core feature, both at the front for virtual meetings and web chats, and at the back for scanning documents or photographing textures to use in digital art.

The vast majority of tablets have just one connection, with the vast majority now using USB-C. This will cover charging and external storage, while some tablets will support wider connectivity to displays and peripherals; a definite plus if you're



**ABOVE** Operating costs: iOS integrates seamlessly with macOS



**ABOVE** A tablet's camera is not as important as a phone's

**BELOWRIGHT** Amazon Fire tablets are built to withstand rough treatment

planning to use your tablet for work.

Bluetooth is also useful for connecting headphones, mice and keyboards, while Wi-Fi connectivity is critical for your internet connection. Wi-Fi 6 should be your absolute minimum, but go for Wi-Fi 6E if you can.

## Ample storage

Storage still tends to be in short supply on tablets, and that can cause problems. Apps, games and media have all become increasingly demanding when it comes to storage space. If you can, opt for 128GB to 512GB over basic 64GB variants, with the latter only suitable for undemanding users – although if you can expand storage through microSD cards or external drives then it's survivable. For instance, films and TV shows can be stored on a microSD card without a big penalty in terms of load times.

## Battery life

Battery life tends to be less of a concern with tablets than laptops, but that doesn't mean it's unimportant.

Even if your tablet never leaves the house, you should look for enough to get through an average day away from the mains, and preferably more. Ten hours is adequate, 14 hours or more is brilliant.

However, watch out for manufacturer figures. These tend to reflect usage with the screen brightness turned right down and only basic and background tasks running. Working at full brightness and running demanding apps or games will see the battery level drop much faster.

The other factor is time. After a year or two of use, your battery's capacity may have dipped down to 80% or so of its original level, so the ten hours of life is now eight. The higher the initial figure, the happier you'll be a few years down the line.

## The whole ecosystem

Here's another factor many buyers miss. When you buy a tablet, you're buying into an ecosystem of cases, covers, keyboards, styluses, cloud services and peripherals. As the biggest seller, the iPad family has the most extensive ecosystem, with

Samsung and Lenovo faring best of the Android tablets.

A range of third-party Bluetooth keyboards and styluses will work across most Android tablets, but getting something specific to your tablet could be tricky. If there's something you know you're going to need to be productive, make sure it's available for your chosen model before you buy.

## Warranties, repair & reliability

Tablets are rarely easy to repair. After all, the emphasis here is on svelte design, and that almost always translates into glues rather than screws. This is why it's worth actually looking to see what warranty your tablet comes with (almost always a single year) and how well it fares for reliability.

The best gauge for the latter is PC Pro's annual Excellence Awards survey. We printed full results for all the biggest-selling tablet brands last month (see issue 351, p29). Apple leads the way for reliability with a 93% satisfaction score to Samsung's 90%, while Lenovo scored 87% and Amazon 85%. All of this is also reflected in the prices of their respective tablets.





Prices correct at time of going to press but are subject to change. \*Based on reader feedback in PC Pro Excellence Awards 2023. See issue 351, p26 for full details. N/A means not enough feedback from readers for reliable results.



		RECOMMENDED		LABS WINNER		
	Amazon Fire Max 11	Apple iPad (10th generation)	Apple iPad Air (5th generation)	Apple iPad Pro 12.9 (6th generation)	Google Pixel Tablet	Honor Pad 8
Rating	★★★★☆	★★★★★	★★★★★	★★★★★	★★★★☆	★★★★★
Base storage option	64GB	64GB	64GB	128GB	128GB	128GB
Starting price <sup>1</sup>	£208 (£250 inc VAT)	£416 (£499 inc VAT)	£558 (£669 inc VAT)	£1,041 (£1,249 inc VAT)	£499 (£599 inc VAT)	£150 (£180 inc VAT)
Storage options <sup>1</sup> (inc VAT)	128GB (£290)	256GB (£679)	256GB (£849)	256GB (£1,369), 512GB (£1,599), 1TB (£2,049), 2TB (£2,499)	256GB (£699)	✗
Cellular option <sup>1</sup> (inc VAT)	✗	64GB (£679), 256GB (£859)	64GB (£849), 256GB (£1,029)	128GB (£1,429), 256GB (£1,549), 512GB (£1,779), 1TB (£2,229), 2TB (£2,679)	✗	✗
Generation	1	10	5	6	1	1
Supplier	amazon.co.uk	apple.com/uk	apple.com/uk	apple.com/uk	store.google.com	hihonor.com
Dimensions (WDH)	259 x 164 x 7.5mm	249 x 180 x 7mm	248 x 179 x 6.1mm	281 x 215 x 6.4mm	258 x 169 x 8.1mm	279 x 174 x 6.9mm
Weight	490g	477g	461g	682g	493g	520g
Support and reliability						
Warranty	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB
Overall satisfaction <sup>2</sup>	79%	86%	86%	86%	N/A	N/A
Reliability satisfaction <sup>2</sup>	85%	93%	93%	93%	N/A	N/A
IP rating	✗	✗	✗	✗	✗	✗
Core components						
Chipset	MediaTek MT8188J	Apple A14 Bionic	Apple M1	Apple M2	Google Tensor G2	Qualcomm Snapdragon 680
Number of cores	8	6	8	8	8	8
Clock speed	2 x 2.2GHz, 6 x 2GHz	3GHz	3.2GHz	3.5GHz	2 x 2.9GHz, 2 x 2.4GHz, 4 x 1.8GHz	4 x 2.4GHz, 4 x 1.9GHz
Installed RAM	4GB	4GB LPDDR4X	8GB	8GB to 16GB	8GB	6GB
Graphics chip	Mali-G57 MP2	4-core A14	8-core M1	10-core M1	Mali-G710 MP7	Qualcomm Adreno 610
Connectivity and expansion						
Wi-Fi	Wi-Fi 6	Wi-Fi 6	Wi-Fi 6	Wi-Fi 6E	Wi-Fi 6	Wi-Fi 5
Bluetooth	5.3	5.2	5	5.3	5.2	5.1
GPS	✗	5G models only	5G models only	5G models only	✗	✗
NFC	✗	✗	✗	✗	✗	✗
Audio jack	✗	✗	✗	✗	✗	✗
microSD	✓	✗	✗	✗	✗	✗
Charging port	USB-C 2	USB-C 2	USB-C 3.2 Gen 2	USB-C 4/Thunderbolt 4	USB-C 3.2 Gen 1	USB-C 2
USB speed	480Mbps/sec	480Mbps/sec	10Gbps/sec	40Gbps/sec	5Gbps/sec	480Mbps/sec
Display						
Screen size and type	11in IPS	10.9in IPS	10.9in IPS	12.9in mini-LED	11in IPS	12in IPS
Max refresh rate	60Hz	60Hz	60Hz	120Hz	60Hz	60Hz
Resolution	2,000 x 1,200	2,360 x 1,640	2,360 x 1,640	2,732 x 2,048	2,560 x 1,600	2,000 x 1,200
Aspect ratio	16:9	1.44:1	1.44:1	4:3	16:10	16:9
Pixel density	213ppi	264ppi	264ppi	264ppi	276ppi	194ppi
Other features						
Rear camera(s)	8MP	12MP	12MP	12MP/10MP	8MP	5MP
Front camera	8MP	12MP	12MP	12MP	8MP	5MP
Fingerprint reader	✓	✓	✓	✗	✓	✗
Face unlock	✗	✗	✗	✓	✗	✓
Battery capacity	27.8Wh	28.6Wh	28.6Wh	40.9Wh	27Wh	7,250mAh
Max charging	15W	20W	30W	45W	15W	22.5W
Charger supplied	9W	20W	20W	20W	15W speaker dock	22.5W
Software						
Base OS	Android 11	iPadOS 16	iPadOS 16	iPadOS 16	Android 14	Android 12
Added layer?	Fire OS 8.3	✗	✗	✗	✗	Magic UI 6.1
App store	Amazon Appstore	Apple App Store	Apple App Store	Apple App Store	GooglePlay Store	Google Play Store
Official accessories						
Keyboard (price inc VAT)	Fire Max 11 Keyboard Case (£90)	Magic Keyboard Folio (£279)	Smart Keyboard Folio (£199), Magic Keyboard (£319)	Magic Keyboard (£379)	✗	Honor Pad 8 Keyboard (not yet for sale in UK)
Stylus (price inc VAT)	✗	Apple Pencil 1st gen (£109)	Apple Pencil 2nd gen (£139)	Apple Pencil 2nd gen (£139)	✗	✗
Other (price inc VAT)	Magnetic Slim Cover (£50)	Smart Folio (£89)	Smart Folio (£89)	Smart Folio (£109)	Pixel Tablet Case (£90)	✗

						
Honor Pad X9	Lenovo Tab Extreme	Lenovo Tab P12	RECOMMENDED OnePlus Pad	Samsung Galaxy Tab S9	RECOMMENDED Samsung Galaxy Tab S9 Ultra	TCL NXTpaper 11
★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
128GB	256GB	128GB	128GB	128GB	256GB	128GB
£133 (£160 inc VAT)	£750 (£900 inc VAT)	£292 (£350 inc VAT)	£374 (£449 inc VAT)	£666 (£799 inc VAT)	£999 (£1,199 inc VAT)	£181 (£217 inc VAT)
✗	✗	✗	✗	256GB (£899)	512GB (£1,299), 1TB (£1,549)	✗
✗	✗	✗	✗	128GB (£949), 256GB (£1,049)	256GB (£1,349), 512GB (£1,449), 1TB (£1,699)	✗
1	1	1	1	9	9	1
hihonor.com	lenovo.com	lenovo.com	oneplus.com	samsung.com	samsung.com	techinn.com
267 x 167 x 6.9mm	328 x 211 x 5.9mm	293 x 191 x 6.9mm	258 x 189 x 6.5mm	254 x 166 x 5.9mm	326 x 209 x 5.5mm	257 x 162 x 6.9mm
499g	740g	630g	552g	500g	737g	462g
1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB
N/A	81%	81%	N/A	85%	85%	N/A
N/A	87%	87%	N/A	90%	90%	N/A
✗	✗	✗	✗	IP68	IP68	✗
Qualcomm Snapdragon 685	MediaTek Dimensity 9000	MediaTek Dimensity 7050	MediaTek Dimensity 9000	Qualcomm Snapdragon 8 Gen 2	Qualcomm Snapdragon 8 Gen 2	MediaTek Helio P60T
8	8	8	8	8	8	8
4 x 2.8GHz, 4 x 1.9GHz	1 x 3.1GHz, 3 x 2.8GHz, 4 x 1.8GHz	2 x 2.6GHz, 6 x 2GHz	1 x 3.1GHz, 3 x 2.8GHz, 4 x 1.8GHz	1 x 3.4GHz, 4 x 2.8GHz, 3 x 2GHz	1 x 3.4GHz, 4 x 2.8GHz, 3 x 2GHz	4 x 2GHz, 4 x 2GHz
4GB	12GB	8GB	8GB	8GB/12GB	8GB/12GB	4GB
Qualcomm Adreno 610	Mali-G710 MP10	Mali-G68 MC4	Mali-G710 MP10	Qualcomm Adreno 740	Qualcomm Adreno 740	PowerVR GE8320
Wi-Fi 5	Wi-Fi 6E	Wi-Fi 6	Wi-Fi 6	Wi-Fi 6	Wi-Fi 6	Wi-Fi 5
5.1	5.3	5.1	5.3	5.3	5.3	5
✗	✗	✗	✗	✓	✓	✗
✗	✗	✗	✗	✗	✗	✗
✗	✗	✗	✗	✗	✗	✗
✗	✓	✓	✗	✓	✓	✓
USB-C 2	USB-C 3.2 Gen1, USB-C 2	USB-C 2	USB-C 2	USB-C 3.2 Gen 1	USB-C 3.2 Gen 1	USB-C 2
480Mbps/sec	5Gbps/sec, 480Mbps/sec	480Mbps/sec	480Mbps/sec	5Gbps/sec	5Gbps/sec	480Mbps/sec
11.5in IPS	14.5in OLED	12.7in IPS	11.6in IPS	11in AMOLED	14.6in AMOLED	11in NXTVISION
60Hz	120Hz	60Hz	144Hz	120Hz	120Hz	60Hz
2,000 x 1,200	3,000 x 1,876	2,944 x 1,840	2,800 x 2,000	2,560 x 1,600	2,960 x 1,848	2,000 x 1,200
5:3	16:9	16:9	7:5	16:10	16:10	5:3
203ppi	244ppi	273ppi	296ppi	274ppi	239ppi	213ppi
5MP	13MP/5MP	8MP	13MP	13MP	13MP/8MP	8MP
5MP	13MP	13MP	8MP	12MP	12MP	8MP
✗	✓	✓	✓	✓	✓	✗
✓	✗	✗	✗	✓	✓	✓
7,250mAh	12,300mAh	10,200mAh	37Wh	8,400mAh	11,200mAh	8,000mAh
20W	68W	30W	67W	45W	45W	18W
10W	68W	20W	✗	✗	✗	18W
Android 13	Android 13	Android 13	Android 13	Android 13	Android 13	Android 13
MagicOS 7.1	Lenovo ZUI 15	Lenovo ZUI 15	Oxygen OS 13.1	One UI 5.1	One UI 5.1	TCL UI 5
Google Play Store	Google Play Store	Google Play Store	Google Play Store	Google Play Store	Google Play Store	Google Play Store
Honor Pad X9 Smart Bluetooth Keyboard (not yet for sale in UK)	Tab Extreme Keyboard (£400)	Keyboard Pack (£120)	OnePlus Magnetic QWERTY keyboard (£148)	Keyboard Folio (£139)	Keyboard Folio (£199)	✗
✗	Precision Pen 3 (included)	Tab Pen Plus (included)	✗	S-Pen (included)	S-Pen (included)	✗
✗	Folio Case (included)	Folio Case (£25)	OnePlus Folio Case (£59)	Book Cover Keyboard (£199)	Book Cover Keyboard (£339)	✗





# Amazon Fire Max 11

Affordable, with premium style and strong peripherals, but the software holds it back

SCORE ★★★★★

PRICE 64GB, £208 (£250 inc VAT)  
from amazon.co.uk

**A**fter years of budget Fire and Fire HD tablets, it's easy to forget that some of the initial Kindle Fire tablets were surprisingly premium affairs, running speedy Snapdragon 800-series CPUs and packing 1600p resolution screens. Now Amazon is back in the mid-range tablet business with the Fire Max 11.

Where standard Fire HD tablets are content-consumption devices, the Fire Max 11 has grander ambitions. It's built around an 11in screen with a 2,000 x 1,200 resolution, while the processor is a quad-core MediaTek MT8188J with two ARM Cortex A78 cores running at up to 2.2GHz, plus six A55 cores running at up to 2GHz. Paired with 4GB of RAM, there's significantly more power on tap here than with the sometimes sluggish Fire HD models, making for a more versatile device.

Amazon has made the most of this by producing solid, affordable peripherals for the Fire Max 11. Prime among them is the folio-style keyboard case, which is better than we expected given the £89 price. The layout is more standard and less cramped than the iPad 10th generation's equivalent, and the keys have decent travel and a nice crisp action.

The trackpad is tiny at 85mm wide and 42mm deep, but it works surprisingly well despite the lack of right-click or two-finger tap functions. You could easily get some work done on it. And while the £35 stylus doesn't



have the artistic powers of Apple's Pencils, it's great for annotations, sketches and doodles.

There's no serious issue with the screen. With a 213ppi pixel density it's slightly grainy, but it can reach brightness levels of nearly 500cd/m<sup>2</sup> and covers 95% of the sRGB gamut. Subjectively, colours don't look as vibrant as on more expensive tablets, but 4K HDR movies on Amazon Prime Video still look great. The audio is also quite impressive, though it loses clarity and starts to sound thin at higher volumes.

As for the performance, the Fire Max 11 isn't going to bother the Lenovo Tab Extreme or any of Apple's iPads in the benchmarks

**ABOVE** The 11in screen has a resolution of 2,000 x 1,200

**Battery life is nothing short of phenomenal; the Fire Max 11 lasted nearly 20 hours in our rundown test**

**LEFT** Peripherals such as the keyboard make it suitable for light work and homework

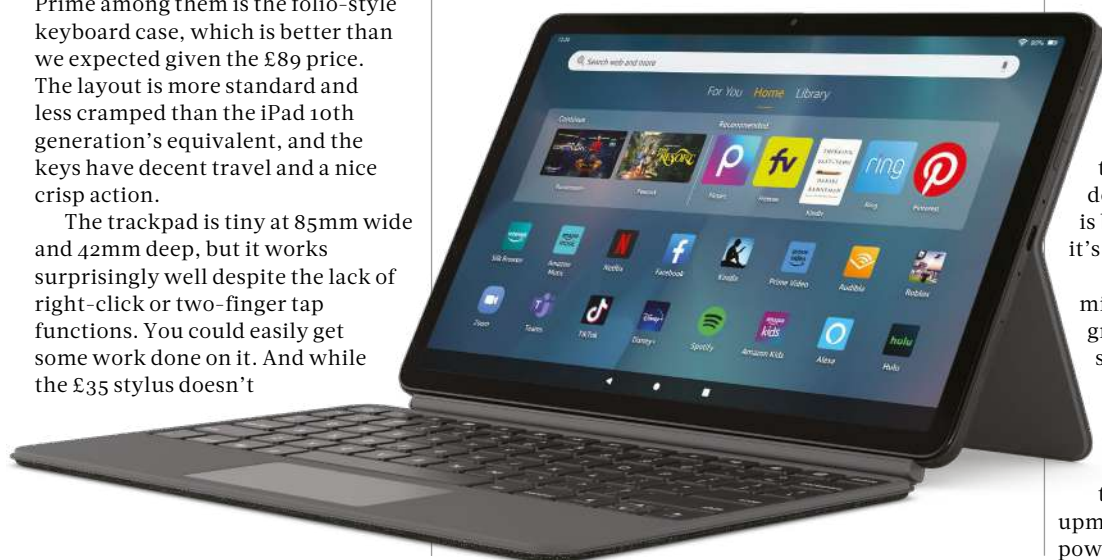
**BELOW** The folio-style keyboard case is decent given the price

graphs, but it's fast enough for basic productivity tasks and light creative work. Gaming is also an option, through poor frame rates in our tests indicate that you might want to compromise on the resolution and

turn down the detail settings. The battery life, however, is nothing short of phenomenal; the Fire Max 11 lasted nearly 20 hours in our rundown test.

In fact, only one thing holds this tablet back: Amazon's Fire OS software. While there are some decent productivity, notes and sketching apps, Amazon's Appstore still falls short of the Google Play Store when it comes to content. We had to sideload many of our test apps, and it's frustrating that so many must-have Android apps just aren't available. Even if you stick to Amazon's favoured apps or Microsoft 365 and Google's web apps, you'll find the Fire OS UI still feels clunky in places, with no support for docking apps or floating windows, and only basic split-screen features. You can't help feeling that an operating system designed for consuming content is being pushed into areas where it's not a natural fit.

Considering the price, that might not matter, and this is a great tablet for using Amazon's services and doing light work at home or on the go. It could even make a decent homework device. But if you're hoping for a tablet that can do more than that, you'll need to look upmarket at more versatile and powerful premium devices.



## Apple iPad 10th generation

Not as fast or feature-packed as the iPad Air, but a better-value tablet for most people

SCORE ★★★★★

PRICE 64GB, £416 (£499 inc VAT)  
from apple.com



There are good reasons why the 10th generation iPad remains the most successful mainstream tablet out there. The updated design, which brings the basic model closer to the iPad Air, works as well held vertically in the hand for web browsing and email as it does placed horizontally on a stand or folio case for productivity work or creative apps. It looks and feels every inch the premium slate.

The lack of an SD card slot for expanding storage won't surprise anyone, but the fact that the single USB-C port is limited to charging and 480Mbps/sec data transfers is disappointing; you won't be connecting to 4K displays at 60Hz. All the same, this is a highly capable device.

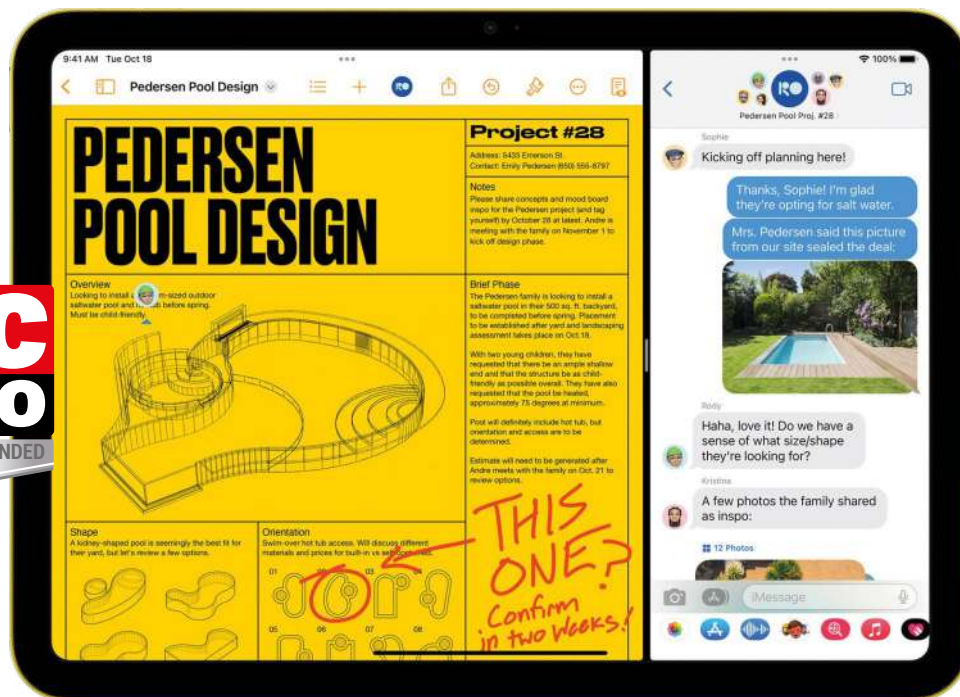
What's more, outside of direct comparisons with the iPad Air and iPad Pro models, the 10.9in screen is fantastic, reaching brightness levels of over 500cd/m<sup>2</sup> with adaptive brightness on and delivering sharp, high-contrast images, despite black levels that veer too much on the high side to be really dark. The screen covers 94% of the sRGB gamut and 68% of DCI-P3, and it's a pleasure to stream video or engage in some photo or video editing. The sound is surprisingly rich and deep for such a small body, and a definite cut above most budget tablets.

Performance is another strength. While it's not in the same league as the M1 and M2 processors inside the iPad Air and iPad Pro models, the iPad's A14 Bionic is still fearsomely fast, beating even some powerful Android competitors in Geekbench 6 and web-based application benchmarks. It's also significantly

quicker in 3D benchmarks, getting close to the scores of the most powerful Android tablets in 3DMark's Wildlife and Wildlife Extreme tests. If you want an iPad that can play the more demanding games in the iPad's extensive library, you don't necessarily need to step up to the iPad Air.

With close to 12 hours of battery life in our tests, it will get you through a good day of work or play without a recharge. The cameras, meanwhile, deliver some of the best stills and video of any tablet, whether you're shooting snaps from the rear or using the front-facing camera to make Facetime calls.

Yet the best reason to invest in the iPad is the software. On the one hand, with its dock and split-screen views,



**ABOVE** The dock and split-screen views in iPadOS make it highly functional

**The iPad's A14 Bionic is fearsomely fast, beating even some powerful Android competitors in Geekbench 6**

**LEFT** The Pencil is great for digital art and taking notes

**BELOW** The Magic Folio keyboard case is okay, but not perfect

iPadOS has become a mature, highly usable environment for tablets, even if it lacks the flexible multi-window support of Windows or macOS. On the other hand, it gives you access to a superb range of productivity, lifestyle

and creative apps that have actually been designed for a tablet rather than a phone.

Just as importantly, the iPad has a rich ecosystem of add-ons to help you make the most of them. We have some reservations about Apple's Magic Folio keyboard case with its slimmed-down punctuation keys and lack of any tilt, but the feel of the keys is crisp and speedy, and it turns the basic iPad into an effective device for getting work done. And while it's annoying that the Pencil requires a Lightning-to-USB adapter, it's a superb tool for digital art and making notes.

The 10th gen iPad still feels overpriced – £499 is a lot to ask for the basic 64GB version and not exactly what you'd call entry-level pricing – but this remains the most powerful and versatile tablet you can buy for this kind of money (although don't ignore the exceptional OnePlus Pad). And the 9th generation iPad from £369, still on sale, is a fine, cost-cutting alternative. If you can afford to spend more, the iPad Air is a stronger choice for serious work or creativity. For most people, though, the iPad will be fast enough, with a good enough screen and connectivity, to do all they want to do

on a tablet. In which case, why spend more?





## Apple iPad Pro 12.9

Too big and expensive for the mainstream, but perfect for well-heeled power users

SCORE ★★★★★

PRICE 128GB, £1,041 (£1,249 inc VAT) from apple.com



The sixth-generation iPad Pro remains the benchmark by which other high-end tablets are judged, thanks to its 12.9in Liquid Retina XDR display and laptop-class M2 processor, which make it a formidably powerful device. It's a handful at 281 x 215mm, with a slightly thicker shell than the smaller iPad to maintain rigidity, but at 682g it's still a lot lighter than any laptop. Until you add the 710g Magic Keyboard, that is. The squarer shape also makes it feel well balanced and easier to hold than, say, the Lenovo Tab Extreme.

The screen is one of the best you'll find. It's bright, hitting 591cd/m<sup>2</sup> in everyday use and reaching over 1,200cd/m<sup>2</sup> with HDR content, with a peak HDR luminance of up to 1,600cd/m<sup>2</sup> for portions of the screen. The miniLED technology ensures deep blacks and stunning levels of contrast, while the colour reproduction is hard to fault, covering 104% of sRGB and 79% of the DCI-P3 gamut. Average Delta E is just 0.24, making it perfect for colour-critical design work, while the 120Hz refresh rate means scrolling and motion is silky. And if you just want to use this awesome display to stream 4K HDR blockbusters, it's brilliant at that as well, even if you'll have some big bars at the top and bottom of the screen.

Audio quality is every bit as good, giving movie scores and sound effects weight and clarity with a degree of stereo spread. You can happily listen to music without feeling you need to connect to a wireless speaker.

The tablet's connectivity also lends itself to more demanding scenarios. You get Wi-Fi 6E and Bluetooth 5.3, but also a USB-C connector that supports Thunderbolt 4, opening up 4K displays, high-speed external drives and docking solutions. If you want to



use an iPad as your main computer, there's nothing standing in your way.

What's more, with the optional – and expensive – Magic Keyboard, it becomes a serious alternative to the MacBook Air or MacBook Pro. The iPad Pro attaches to the rear of the keyboard through a magnetic mount, then hovers over the edge of the keypad, for a more ergonomic work environment than traditional tablet keyboards. It helps that it's a laptop-grade effort, with large, flat keys and a mostly standard layout. Plus the kind of action and haptic feedback that quickly gets you typing at speed.

Apple has worked hard to make the iPad Pro work in this way, and while there are some frustrations about the way its Stage Manager multitasking



**ABOVE** The bright, colourful screen is among the best you'll find on a tablet

**It chews through even the most demanding apps, and no other tablet makes such an effective – if expensive – games machine**

**LEFT** The optional Magic Keyboard will get you typing at speed in minutes

**BELOW** The iPad Pro is a serious alternative to a MacBook

works, it still gives you a familiar environment with resizable windows and proper multitasking. When you're working on tasks that involve collating information across multiple apps or documents, it's much easier to do so on the iPad Pro than nearly any other tablet – aside from the Lenovo Tab Extreme and Samsung Galaxy Tab S9 Ultra.

Beyond all this, the M2 processor ensures you have all the power you need. Paired with 16GB of RAM on the 1TB version we tested, the iPad Pro trashed the competition across all our benchmarks. It chews through even the most demanding apps, and no other tablet makes such an effective – if expensive – games machine. When console ports start hitting Apple's App Store, you can be sure that the iPad Pro will cope. Only the battery life is slightly disappointing, with the biggest iPad running dry in short of 12 hours of 1080p video playback.

Of course, price is the iPad Pro's big problem. Even the entry-level 128GB version is a fearsome £1,249, with the 1TB version clocking in at a whopping £2,049. If you then want to add the Magic Keyboard and Apple Pencil, you could be looking at spending the best part of £500 on top of that. For that kind of money you could have a 13in or 15in MacBook Air with more RAM and storage, meaning you really have to want the tablet form factor and be happy with iPadOS's limitations to make it worth your while. Still, if that's the case, have no doubts. This is the still the best big-screen tablet of the bunch.



## Lenovo Tab P12

The P12 punches above its price, with specs and speeds that would normally push a tablet well over £400

SCORE ★★★★★

PRICE 128GB, £292 (£350 inc VAT)  
from lenovo.com

The Tab P12 slots in beneath the Pad Extreme and the P12 Pro in Lenovo's tablet line, giving you a big 12.7in screen but no OLED technology, and a good spec without being exceptional. For example, rather than a high-end Qualcomm Snapdragon 870 CPU, here the processor is a more modest MediaTek Dimensity 7050, while the panel is a 2,944 x 1,840 resolution IPS display.

The design is typical Lenovo, with a slim but robust aluminium shell in a two-tone storm grey colour, and a narrow 8mm bezel around the screen. It doesn't have the brightness, contrast or vivid colour of the OLED panel on the Tab Extreme, but on its own terms it's perfectly respectable, with a maximum brightness of 434cd/m<sup>2</sup> in its Vibrant colour mode, with 95% coverage of the DCI-P3 gamut.

Colour accuracy isn't bad on the Vibrant setting, and even better on the 405cd/m<sup>2</sup> Standard setting, where it has an average Delta E of just 1.04.

Either way, it's a good option for streaming video or browsing the web, particularly with a four-speaker JBL-manufactured Dolby Atmos sound system that produces richer and more spacious audio than you'll find on most other tablets at this price. It's also great for streaming games, once you hook up a Bluetooth controller and have the Nvidia GeForce Now or Xbox Games Pass apps installed.

As for productivity, there's an optional £120 keyboard case, while Lenovo frequently bundles the Tab P12 with its Tab Pen Plus stylus. We tried the latter, and while it's a bit lightweight and plasticky if you're used to Samsung or Apple's styluses, it still offers 4,096

levels of pressure and tilt sensitivity, making it well worth having for taking notes or digital art in supporting Android apps.

On connectivity, the P12 is a step down from the Tab Extreme.

Wi-Fi is standard Wi-Fi 6 rather than the speedier 6E, while the USB-C port used for charging is 480Mbps/sec USB 2 rather than 5Mbps/sec USB 3.2 Gen 1. Still, both are adequate for a basic Android tablet, even if they limit what you might want to connect it to.

Unlike the Tab Extreme, the P12 has no ambitions to replace your normal laptop, but it can be a good productivity partner. You can use Lenovo's Freestyle app to use the P12 as a wireless second screen, although both devices must be signed into the same Lenovo ID. This is perfectly possible on non-Lenovo laptops, but

**ABOVE** The IPS display is a good option for streaming video or browsing the web

**The P12 feels slick and speedy in everyday use, and coped well with creative tasks as well as the basics**

**LEFT** The 8MP rear-facing camera is handy for taking the occasional snap

**BELOW** The P12 is an excellent option for those on a budget

a pain nonetheless. Used solo, it supports split-screen views and floating windows, so you can multitask in comfort on the move.

The P12 also works well for video calls and meetings, thanks to a 13MP

front-facing camera that produces detailed, well-exposed pictures, and a mic array that does a solid job of picking up your voice with little echo or background racket. The 8MP rear-

facing camera isn't as good as the one on the front, but it's still handy for the occasional snap or copying and scanning paperwork.

Needless to say, performance isn't in the same class as the iPad 10th generation or even the OnePlus Pad, let alone the Samsung Galaxy Tab S9 duo or the Tab Extreme. Yet the P12 feels slick and speedy in everyday use, and coped well with creative tasks as well as the basics. You can even squeeze enough 3D power from the Dimensity 7050 CPU to play the odd game, though not at the native resolution or with detail settings set to high.

Battery life could be better – the P12 managed a little over 11 hours of 1080p video playback before it ran out of puff – but overall Lenovo's cheaper premium slate is cracking value, giving you a good screen, excellent audio and decent levels of performance at a reasonable price. If you want a more serious productivity device, spend more on the OnePlus Pad, but if you just want the best of the more affordable Android tablets, this is an excellent option.





## OnePlus Pad

Smart design, good specs and solid performance in a tablet that doesn't cost the earth

SCORE ★★★★★

PRICE 128GB, £372 (£449 inc VAT)  
from [oneplus.com](https://www.oneplus.com)



It's taken a long time for OnePlus to get into the tablet game, but the OnePlus Pad shows it adopting the same successful approach as on its phones. This means not only selecting fast components for the budget and developing its own distinctive software, but also making smart design choices that focus on how people might actually use the OnePlus Pad.

That starts with the 11.6in screen and its unusual 7:5 aspect ratio. Apple decided long ago that 16:9 widescreen wasn't the best fit for tablets; it works brilliantly for watching movies, not so much for productivity or design work. Or for reading or browsing with the tablet held in portrait mode. OnePlus has gone even better. With its squarer aspect ratio, the OnePlus Pad appears to have a similarly sized screen to some of the larger 12.9in to 14in tablets, but without the bulk. Sure, you'll have bigger bars at the top and bottom when you're bingeing Netflix, but it makes for a more versatile device.

It's beautifully made as well, with a slim, rounded profile and a dark green, satin-finish aluminium shell that looks great – and feels great, too. You'll still want a case to protect it, but it feels as solid and as premium as any iPad or Galaxy Tab. We do have reservations about the chunky, circular camera array at the rear, however, which is massive considering it holds only a single 13MP camera. It takes sharp, bright and natural-looking photos, though, as does the 8MP front camera.

The screen itself is excellent for an IPS display. We measured the maximum brightness at 528cd/m<sup>2</sup> and the contrast at 1,451:1. It covers a fantastic 93% of the DCI-P3 gamut in the Vivid colour mode, ensuring rich

and vibrant colours whether you're streaming video or editing photos, with good colour accuracy to boot. What's more, it updates at 144Hz, giving you gorgeous, smooth scrolling. The sound is equally fantastic, giving you more body and a much wider stereo spread than most rival tablets can achieve.

The aspect ratio makes even more sense once you have the Pad sitting in its optional keyboard folio. This clips onto the back of the tablet magnetically, with a large round hole for the camera module

and the keyboard powered from the tablet through pogo pins just about the keypad. This has one negative effect, however, as with the tablet sitting in position on the pins, there's no way to change the fairly upright viewing angle.



**ABOVE** The excellent 11.6in screen has an unusual 7:5 aspect ratio

On the plus side, the keyboard is very good. It's taken a hit in size to fit within the limited width of the tablet, but the keys are well sized and the action tight. I wouldn't want to make too much use of the tiny 80mm by 42mm touchpad, but it's fine for basic productivity work.

**It's beautifully made, with a slim, rounded profile and a dark green, satin-finish aluminium shell that looks great – and feels great, too**

With the keyboard fitted, the OnePlus Pad makes a functional secondary computer, perfect for research and notes or getting a draft of a document done on the

move. And while Android isn't as strong as iOS on creative apps, the OnePlus Pad can handle those, too. It helps that OnePlus has really thought about the UI for its Oxygen OS spin on Android, going for an iPad-style dock at the bottom of the screen and supporting both floating windows and split-screen views (though not all apps support them).

This is a fast Android tablet, with the same MediaTek Dimensity 9000 processor as the Lenovo Tab Extreme and 8GB of RAM. That puts it near the top of the Android tablets on test for performance, though behind the iPad Pro and iPad Air, and there's enough 3D horsepower to run most games at medium to high detail settings. What's more, battery life is about as good as it gets. With over 17 hours in our 1080p video rundown tests, only the Amazon Fire Max 11 and TCL NXTpaper 11 showed more longevity.

There are some disappointments – we'd have liked to have seen Wi-Fi 6E, a faster USB-C connection and more storage size (128GB is your only choice) – but if you're looking for a tablet that can work hard and play hard, this is the best Android option outside of Samsung's Galaxy Tabs. And it won't do so much damage to your wallet.

**LEFT** The optional keyboard folio clips to the back of the tablet

**BELOW** The keyboard has well-sized keys and a speedy action



# Samsung Galaxy Tab S9 Ultra

The best of the big-screen Android tablets, going toe-to-toe with the iPad Pro

SCORE ★★★★★

PRICE 256GB, £999 (£1,199 inc VAT) from [samsung.com](https://www.samsung.com)



Even when other Android tablet manufacturers seemed to give up, Samsung kept plugging away, delivering bigger, better and more capable Galaxy Tab S tablets with each new generation. That really paid off with the Galaxy Tab S8 series, arguably the first set of Android tablets to give Apple's iPad range serious competition. And now that goes double for the Galaxy Tab S9 Ultra, which is Samsung's finest tablet yet.

This isn't just about the hardware, Samsung has nailed usability with its One UI, so that you can manage multiple windows and multitask between them, just as you would in Windows or macOS. Even the window-snapping features work in much the same way. And while Lenovo has followed Samsung in providing an alternative, desktop-style UI – this activates when you connect a monitor and keyboard – Samsung's DeX experience is slicker and more consistent.

Place the Galaxy Tab S9 Ultra inside its £339 book cover keyboard, and you have a very viable laptop replacement, provided you can work with a more limited set of Android and web-based apps. It's a shame the typing experience isn't quite up there with Apple's Magic Keyboard or Lenovo's Tab Extreme equivalent, though, especially given the price.

Providing the S-Pen as standard is another smart idea, giving you everything you need for making notes, sketching, annotation and lightweight digital art out of the box.

This doesn't mean the hardware isn't worth shouting about. Quite the opposite, in fact. Samsung has done just about everything possible to minimise the bulk of this huge tablet, while ensuring there's still enough



rigidity and something you can grip. It's surprisingly robust for a big device that's only 5.5mm thick, and is even IP68-rated against dust and water.

Other tablets give you a screen on which you can watch movies;

the S9 Ultra gives you one on which you could probably make them, though it's good at the entertainment stuff as well. It reaches SDR brightness levels of 592cd/m<sup>2</sup>, and HDR brightness levels of 765cd/m<sup>2</sup>.

It covers 100% of the sRGB colour gamut with a volume of 181%, and 100% of DCI-P3 with a volume of 128%. Colour accuracy is near perfect, with an average Delta-E of under 0.2. It's almost wasted streaming 4K HDR video from Netflix and Amazon Prime, even if it's a splendid sort of waste. You feel like you should be doing something creative to justify owning this tablet.

**ABOVE** For many people, this is the big-screen tablet of their dreams

**The best thing about the Galaxy Tab S9 Ultra is its performance. It kicks sand in the face of even the mightiest Android tablets**

**LEFT** The superb screen sparkles whether consuming or creating content

**BELOW** The Galaxy Tab S9 Ultra is a viable laptop replacement

As far as connectivity is concerned, the S9 Ultra can't compete with the Thunderbolt 4 port on the iPad Pro: USB 3.2 Gen 1 translates into 5Gbps/sec, which means that DeX struggles with refresh rates when handling external

monitors at resolutions above 1080p. Yet Samsung still has one key advantage over any Apple device, enabling you to boost your storage or import photos through a microSDXC slot.

The best thing about the Galaxy Tab S9 Ultra, though, is its performance. It kicks sand in the face of even the mightiest Android tablets – even you, the Lenovo Tab Extreme – while giving the M1 iPad Air and M2 iPad Pro the closest thing they've ever had to competition. Whether you're editing 4K video or high-resolution photos or simply playing *Diablo Immortal*, the Tab Extreme will feel flawlessly speedy and responsive. And while the massive 11,200mAh battery only gives you around 13 hours of video playback before shutting down, that's still good enough for a solid day of work and entertainment, and what do you expect with a screen this size?

In terms of hardware and the core experience, this isn't just the best Android tablet out there, but a real alternative to the iPad Pro. Yet we still have caveats. The S9 Ultra is extremely expensive, and you still won't have access to the full range of pro-level creative and business apps that Apple users take for granted. Yet there's probably enough out there for most mainstream users, and only professionals needing specific tools will struggle to find appropriate software. For many people, this is going to be the big-screen tablet of their dreams.





## Apple iPad Air (5th generation)

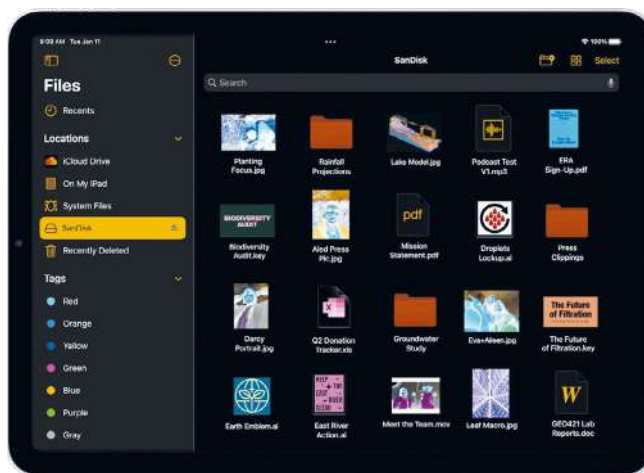
Style, strong features and fantastic performance at a price you might actually be able to afford

SCORE ★★★★★

PRICE 64GB, £558 (£669 inc VAT)  
from apple.com

Apple's fifth-generation iPad Air comes at a steep premium over the base 10th-gen iPad, but it's hard to grumble when it has so many of the strengths of the iPad Pro. These include best-in-class performance and a range of accessories that can transform it into a mobile powerhouse. The IPS screen isn't as stunning as the Pro's Liquid Retina XDR display, but it's still one of the best you'll find.

There's little difference between the 10th-gen iPad and the Air in terms of the design. Both have 10.9in screens with slender frames, a Touch ID button on the top (in portrait mode) and volume buttons on the right.



The iPad Air's screen is laminated, improving contrast and making it feel solid when you tap. The resolution is the same, as is the 500cd/m<sup>2</sup> brightness in the specs, but in practice the iPad Air offers slightly higher coverage of both the sRGB and DCI-P3 colour gamuts, while also having darker blacks. Colour reproduction is excellent on both, however, and there's not a night and day difference, side by side.

Connectivity is another matter. Where the iPad has a straight USB-C connector for charging, the iPad Air's is more versatile, supporting 4K and 6K HDR displays at up to 60fps, along

**ABOVE** The display is one of the best you'll find on an 11in tablet

**BELOW** The Magic Keyboard raises the screen over the keys



with data transfer speeds of up to 10Gbits/sec. What's more, only the Air and Pro support the Stage Manager UI that makes working on external displays so much more productive, with windows-based multitasking and a proper desktop view.

This also makes the iPad Air a better bet if you're prepared to splash out £319 on the Magic Keyboard, with its ingenious hinged, magnetic rear holding the Air's screen just over the top row of keys. It's still one of the few tablet keyboards that can take professional use, with a less cramped layout than the iPad's

Magic Folio keyboard and a slightly clickier action. Clamp it on, and the iPad Air becomes a thoroughly workable laptop replacement, with the performance to match.

Sure, the iPad Air isn't as fast as the iPad Pro, but it's speedier than its Android rivals, and the Air will handle all the iPad's creative and productivity apps, and even double as a console if you plan to run games. Both are excellent tablets, and the Air is going to be overkill for less ambitious, casual users. But if you're looking for a tablet that can tackle just about anything, the iPad Air is still worth the extra.

## Google Pixel Tablet

A beautifully designed tablet for home users, but not ideal for more serious workloads

SCORE ★★★★★

PRICE 128GB, £479 (£599 inc VAT)  
from store.google.com

Google's premium tablet takes a different tack to Apple, Samsung and Lenovo, focusing less on mobile productivity, creativity and entertainment, and more on life at home. There's no keyboard or stylus accessory for this one. Instead Google bundles in a speaker dock that charges up the tablet while it's not in use. With its rounded contours, clamped magnetically to the dock at a slight upward angle, it resembles an over-sized smart display.

This is a good thing providing you want to use the Pixel Tablet for the stuff it's best at. It's a great entertainer, for example, particularly as the speaker dock adds a warmth and power to the sound that can't be



replicated by a normal tablet – even if the iPad Pro makes a pretty good case. The Pixel Tablet is about as good for background music as you're going to get without a separate streaming speaker system.

Google's slate also makes sense as a central hub for any Google Home devices, and one of the best ways to showcase photos in the home, with the added convenience that you can edit them in situ using Google Photos. You can even remove unwanted objects (or people) from your shots using the Magic Eraser tool.

The screen is good, if not in the same league as the iPad Air,

**ABOVE** The Pixel Tablet is a fine central hub for Google Home devices

**BELOW** The bundled speaker dock can also charge the tablet



Galaxy Tab S9 or OnePlus Pad. We measured brightness levels of 453cd/m<sup>2</sup>, while it covers close to 99% of the sRGB gamut and 78% of DCI-P3. Watch HDR movies and the 11in, 2,560 x 1,600 resolution display gives you plenty of detail and natural colours. Just without the pop of pricier OLED screens.

Meanwhile, Google's Tensor 2 processor has the performance to run a wide range of apps, performing solidly across our benchmarks, and

delivering good frame rates in our 3D graphics tests. Battery life is more than adequate, reaching 13hrs 46mins in our rundown test.

This is a great tablet, then, for use around the home, but is it as versatile as the OnePlus Pad, iPad Air or Galaxy Tab S9? We're not so sure. Though the interface allows for widgets and split-screen views, it doesn't really work for productivity, even with the optional folio case with its adjustable stand. It's good value, and perfect for sofa surfing and Netflix binges, but it's more of a smart home hub and entertainer than a serious all-rounder.

## Honor Pad 8

A decent budget big-screen tablet that's well built, slim and lightweight, but it's not without some minor flaws

SCORE ★★★★★

PRICE 128GB, £150 (£180 inc VAT)  
from [hihonor.com/uk](https://hihonor.com/uk)

For a budget tablet, the Honor Pad 8 comes with some big ambitions.

For a start, its all-aluminium unibody construction looks and feels as if it belongs to a more expensive model. Just 7.9mm thick and weighing a mere 520g, it's also very easy in the hands. It packs in an unusually large 12in screen, and while it doesn't have the kind of resolution you'll find on the Samsung Galaxy Tab 9 or Lenovo P12, a pixel density of 194ppi still looks relatively crisp. The Pad 8 proves that you can have a big-screen tablet at an entry-level price.

What's more, that screen isn't bad at all. We measured the maximum brightness at 406cd/m<sup>2</sup> and strong contrast levels of 1,651:1. It covers a



**ABOVE** The large 12in screen is surprisingly bright and colourful

**BELOW** The aluminium casing gives the tablet a touch of class



credible 97% of the sRGB colour gamut and 72% of DCI-P3, and colour accuracy is respectable, with a Delta E of 1.51. Even the audio isn't bad at lower volumes, with eight cavity speakers hidden in the body dishing out a spacious sound with a hint of bass, though it soon gets harsh and trebly as you turn the volume up.

The Pad 8 runs Honor's Magic UI 6 software, a rejigged Android 12 with a floating dock at the bottom of the screen and a series of homescreens to host your apps. It's not the most stylish or elegant UI, but it supports a basic form of multitasking complete with

split-screen views and floating windows, and while these are initially set up to run Honor's own Email, Files and Gallery apps, it's easy enough to add Google's or a third party's if you – quite rightly – prefer the stock Android apps.

Connectivity is basic, with a USB-C 2 port for charging and an SD card slot, and this is one of the few tablets on test with Wi-Fi 5 connectivity rather than Wi-Fi 6 or 6E. But the real proof that

this is a budget option is performance, with the Pad 8 struggling to keep up with pricier Android tablets across the board. It falls far behind in 3D graphics, with dodgy frame rates in the basic Wildlife test.

You won't notice this while running basic productivity apps, browsing or checking your email, where the Pad 8 feels reasonably slick, but it only makes sense as a cheap device for consuming content, particularly with the big screen. If you're looking for something with more potential, you'll need to spend more.

## Honor Pad X9

Premium looks, a bright display and outstanding battery life at a bargain basement price

SCORE ★★★★★

PRICE 128GB, £133 (£160 inc VAT)  
from [hihonor.com/uk](https://hihonor.com/uk)

At just £160 inc VAT, the Honor Pad X9 is the cheapest tablet in this Labs. To its credit, you'd be hard pressed to see that on first impressions. There's not a hint of plastic in the casing, just a metallic unibody shell. It's fairly slim and light at 6.9mm and 499g, and while the thicker bezels and overall fit and finish tell you that this isn't a Samsung Galaxy Tab S9-beater, it's by no means awful. The worst thing you can say is that Honor doesn't specify whether the glass is toughened, though nothing suggests that it isn't, and that it's more prone to fingermarks and smudges than premium tablet screens.



**ABOVE** The quality of the display belies the Pad X9's low price

**BELOW** It's well made and lightweight, too



You won't find much amiss with the display, either. True, the 11.5in screen size and 2,000 x 1,200, 203ppi resolution means you won't get the crystal clarity of a QHD or Retina display, but it's punchy, hitting 462cd/m<sup>2</sup>, and colour reproduction is a lot better than you might expect. This budget screen covers 98% of the sRGB colour spectrum and 73% of DCI-P3, while colour accuracy is also fine, with an average Delta E of 1.18. We've seen tablets twice the price with screens that don't measure up.

Of course, there are signs of cost-cutting. Wireless is old-school Wi-Fi 5 rather than

modern Wi-Fi 6, and the USB-C port is stuck on the old-school USB 2 standard. Charging speeds are limited to around 18W, and Honor throws only a 10W charger in the box. Nor are we sold on the iPadOS-aping looks of the MagicOS 7 software, even if it does support split-screen views and floating windows in an elementary fashion.

Software issues meant we couldn't run the full selection of benchmarks on the Pad X9, but the

web-based apps we did run put speeds a smidgeon higher than the Honor Pad 8 and TCL NXTpaper 11. That doesn't mean you're getting mid-range power at a low-end price, but the overall experience is slick without too much slowdown. You should lower your expectations – and your detail settings – if you're thinking about playing games.

That's not unreasonable given the price, especially when the Pad X9 exceeds expectations in many areas, including battery life. Spending more will get you a better slate, but if your budget is limited, you'll struggle to find anything much better.



## Lenovo Tab Extreme

An awesome screen and some great peripherals, but the Tab Extreme can't match Samsung's titan

SCORE ★★★★★

PRICE 256GB, £720 (£900 inc VAT)  
from lenovo.com

There's no getting away from it: the Tab Extreme is a bruiser of a tablet, equipped with a huge 14.5in OLED panel that would look big on a laptop. The spec is as impressive as the screen, with a MediaTek Dimensity 9000 processor, 12GB of RAM and 256GB of storage as standard. But then the Tab Extreme is priced to match, with a £900 tag that makes it the most expensive non-Samsung Android tablet.

The display hits SDR brightness levels of 432cd/m<sup>2</sup> and covers 100% of both the sRGB gamut and the wider DCI-P3. With perfect black levels comes fantastic contrast, and colours are as rich as you could wish for. Throw in a superb JBL speaker system, with a serviceable impression of Dolby Atmos



sound, and you have one of the top tablets for watching TV and movies.

Attach the Extreme to its optional keyboard and it works as a laptop, too, with the clever hinged back panel, inspired by Apple's Magic Keyboard, floating the screen almost over the keyboard in front. The keyboard is the biggest, with the best layout, of any that we've seen this month, even if the price of £400 is a tad shocking.

Lenovo's UI gives you a choice of an enhanced tablet mode with floating windows and split-screen views, or a desktop "PC" mode with full resizable

ABOVE The huge 14.5in screen wouldn't look out of place on a laptop

BELOW The optional £400 keyboard is a triumph of design



windows and a taskbar. It's not perfect – you can't have two browser windows open at the same time – but it makes for a familiar and productive work environment.

Performance is predictably good, even if the Tab Extreme can't catch the Galaxy S9 tablets or the premium iPads at the top of the table. And while you're

limited to under 12 hours of battery life, that's understandable given the screen size and processing power.

In fact, the only thing that stops us recommending the Tab Extreme is its price. £900 is a lot of money for the tablet without the £400 keyboard,

putting it a little too close to the Samsung devices, which have better software, and way beyond the smaller but still brilliant OnePlus Pad. You can't help thinking it would make an incredible Windows laptop, but with Android's limitations the package doesn't quite add up.

## Samsung Galaxy Tab S9

All the power of the Tab S9 Ultra but with a more manageable size and price tag

SCORE ★★★★★

PRICE 128GB, £666 (£799 inc VAT)  
from samsung.com

The Samsung Galaxy Tab S9 Ultra is one incredibly powerful tablet, but with its 14.6in screen and corresponding size, it isn't for everyone. The Tab S9 is a more mainstream proposition, partly because its 11in size is closer to what most people expect from a tablet, and partly because, with prices starting from £799, it's more affordable.

You still get nearly the power of the S9 Ultra, as the Tab S9 features the same Qualcomm Snapdragon 8 Gen 2 processor, though with 8GB rather than 12GB of RAM. In our benchmarks, this didn't make a huge amount of difference. Both tablets are prodigiously powerful,



and it's only when working on 4K video files in Adobe Premiere Rush that we spotted any vaguely significant speed difference. In fact, the Tab S9 achieved slightly faster results in 3D graphics tests, making it one of the best options out there for mobile Android gaming.

The AMOLED screen might be smaller than the S9 Ultra's, but it doesn't lose anything in terms of quality. It can't quite reach the eye-searing levels of brightness as the iPad Pro or Lenovo Tab Extreme – SDR brightness levels are around 582cd/m<sup>2</sup>, with HDR content going

ABOVE The AMOLED screen is up to usual Samsung standards



RIGHT The bundled S-Pen goes some way to justifying the comparatively high price

slightly higher – but it's excellent for video streaming, particularly with 4K HDR content, and colour accuracy is easily good enough for image-editing purposes.

The AKG-designed audio system doesn't let the side down, either, coping well with bass-heavy tracks and soundtracks. If you need to use a tablet for video chats and meetings, you'll be glad to know that both the front and rear cameras can capture high-quality stills and video, complete with clear sound.

While its battery is smaller than the S9 Ultra's, longevity isn't an issue; the Tab S9 will happily get through 13 hours of video playback, not to mention a full day of use. And when you need to top it up, a 45W charger will get it back to nearly 49% in half an hour. Not that one is included in the box.

Price is the Tab S9's biggest problem. It looks and feels every inch a premium tablet, and the bundled S-Pen works a treat for sketches, doodles, precision image editing and handwritten notes. Yet it costs a lot more than the OnePlus Pad, not to mention the base-level iPad. It competes with the iPad Air and delivers a similar experience, but Apple still has the advantage when it comes to apps.

## TCL NXTpaper 11

A fascinating tablet/e-reader hybrid, hampered by slow speeds – but that's reflected in its low price

SCORE ★★★★★

PRICE 128GB, £181 (£217 inc VAT)  
from techinn.com

All credit to TCL. While other manufacturers are pushing out endless tablets that stick to similar designs, it's gone for something a little more innovative. The clue is in the name. TCL's NXTpaper 2 technology is designed to give you a display that looks and feels less like a super-bright, glossy tablet screen and more like a full-colour e-paper effort.

With its narrow bezels, matte finish and minimalist aluminium shell, the NXTpaper 11 will never be mistaken for your average Android slate. Thankfully, at just 462g and 6.9mm thick, it's very comfortable to hold.

The screen works a treat for reading ebooks, digital magazines

and comics. It's easy on the eye like an ebook reader, but with the kind of brightness and colour you'd expect from a tablet. Yet whack the brightness up to the maximum 407cd/m<sup>2</sup> and you can still have fun streaming video, browsing the web and running apps. In fact, the matte surface on the screen makes it a better bet for use outdoors. Nor is the colour reproduction to be sniffed at, with 94% of the sRGB gamut and 78% of DCI-P3. However, blacks never look really black and contrast also suffers,

**ABOVE** The paper-like screen is ideal for reading ebooks

**BELOW** The NXTpaper 11 is quite unlike the other tablets on test



so be aware that some compromises are involved.

There are some further compromises on features. Wireless networking is stuck at Wi-Fi 5, the USB-C port only supports USB 2. Then there's TCL's own UI on top of Android 13. It's a fairly basic effort with several homescreens to host your apps and no support for floating windows or split screens. At least the audio is clear, with a spacious stereo effect, though it's slightly tinny.

But the biggest issue with this tablet is performance. With its eight-core MediaTek Helio P60T processor and 4GB of RAM, the NXTpaper 11 was the slowest tablet on test in most of our benchmarks, only pulling ahead of the Honor Pad 8 in the 3D graphics benchmarks because the latter has such a woefully weak GPU. In everyday use, the TCL doesn't feel particularly slow, but it

hasn't got the snap and instant response of the speedier Android tablets. Battery life is brilliant – it's the third longest-lasting tablet in the Labs – but how much you like the NXTpaper 11 will depend on how much you value its hybrid style.

# The ultimate games machines?

Apple is leading the way for gaming on tablets, but we can't say the same for Android

Tablets aren't just about mobile productivity or creative apps: they're also becoming impressive games machines. We know there's a lot of excitement about the Steam Deck and similar handheld consoles, but tablets can now provide high levels of CPU and GPU horsepower, along with a bigger screen that's a better fit for more complex UIs. And while you don't have a built-in controller, you can hook up an Xbox controller via Bluetooth, prop your tablet up in a stand or case and have everything you need for gaming on the move.

Everything, that is, except the games – at least if you're running Android. Apple long ago saw the potential of iPad gaming, and has invested heavily in turning Apple Arcade and the App Store into serious destinations for mobile play. From iPad versions of *Civilization VI* and *Divinity: Original Sin 2* to original titles such as *Shinsekai: Into the*

*Depths* and *Fantasia*, Apple has consistently delivered a strong lineup of titles optimised for tablet play.

What's more, the new iOS version of *Resident Evil Village* proves that, with the right hardware, an iPad can handle ambitious, current-generation console games. The game requires an M1 or M2 chip, but it looks and feels uncannily close to the console version running on an Xbox Series console or PlayStation 5. And this is just the beginning, with iPad versions of the *Resident Evil 4* remake, *Death Stranding* and *Assassin's Creed: Mirage* expected in the next few months.

Where is Android in all of this? Not in such a great state. *Genshin Impact*, *Diablo Immortal*, *Fortnite* and *Call of Duty Mobile* provide console-like experiences on Android tablets, albeit with

cash-grabbing microtransactions smuggled in, yet console-grade titles remain a way off. It's hard to know whether this is due to the established unwillingness of Android users to pay up front for software, or to the lack of a standardised hardware. Either way, it's an opportunity being lost.

In fact, the best way to game on Android isn't to play locally, but to stream instead. Install the Xbox Games Pass and GeForce Now apps and you're good to stream from the leading gaming services. Or why not install the Steam Link or Moonlight

streaming apps and stream straight from your gaming PC? With Sony's PS Remote Play or the third-party PSPlay app, you can even stream games from your PS 5. You won't end up playing on the move, but at least you can play your favourite games wherever you want at home. ➔

**BELOW** The iOS version of *Resident Evil Village* sets a high bar for tablet gaming





## How we test

We put our tablets through a barrage of cross-platform benchmarks, starting with Geekbench 6 to test CPU performance. The single-core aspect puts the most powerful core to the test, while the multicore section reveals any weaknesses – while most ARM chips have eight cores, some are much faster than others. Geekbench's Compute section is a synthetic test of the GPU.

For more real-world-style tests, we use a selection of browser-based benchmarks. Basemark Web 3 and WebXprt 4 use a similar approach, with tasks such as photo enhancement, productivity and GPU acceleration. JetStream 2 gives a good indication of how tablets will cope with complex JavaScript and apps based on WebAssembly. And Kraken is an out-and-out JavaScript benchmark.

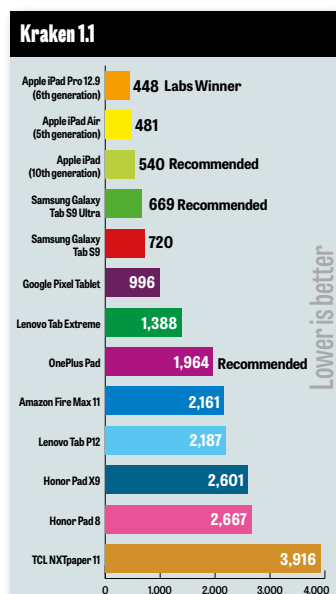
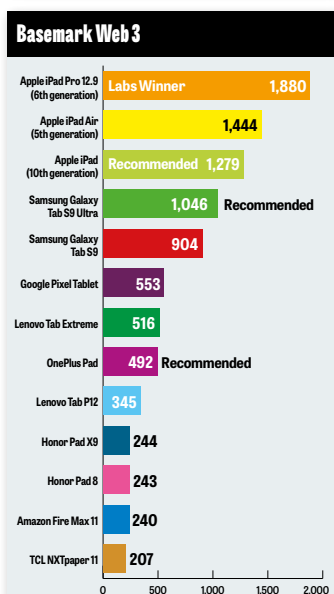
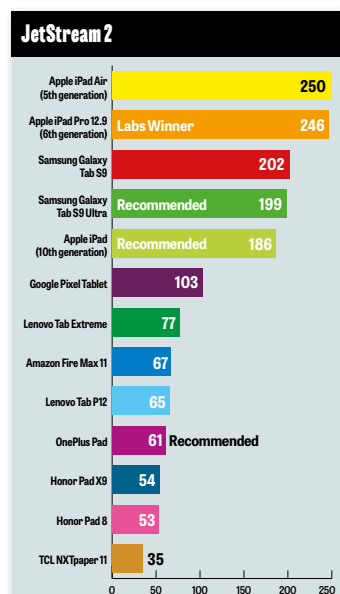
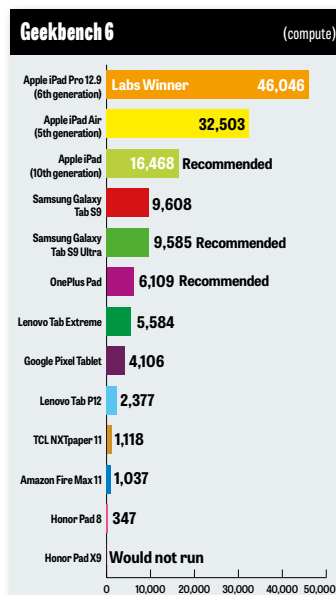
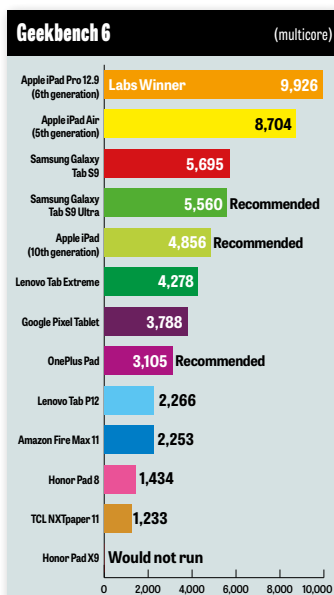
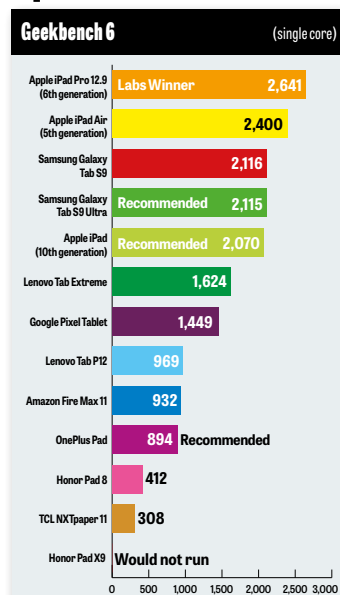
We also use 3DMark and GFXBench to torture-test the graphics chips. 3DMark's Wild Life test takes advantage of more advanced features, while the GFX benchmarks are more basic. Note that the offscreen test gives a better indication of raw speed, as it won't be affected by refresh rates or higher resolutions.

Our screen tests cover colour coverage, accuracy (Delta E), brightness and contrast (although OLED screens are effectively perfect). In the crucial DCI-P3 space, favoured by film-makers, we print both gamut coverage and volume. If the latter figure is above 100%, it means it stretches even further than that rich colour space.

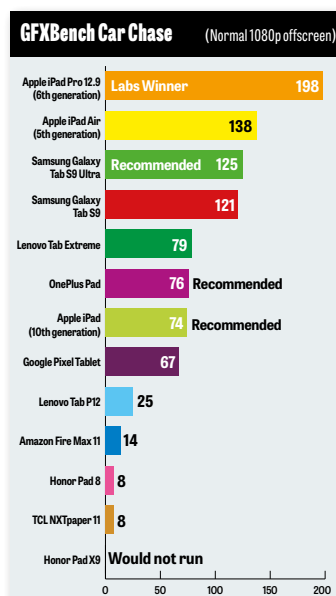
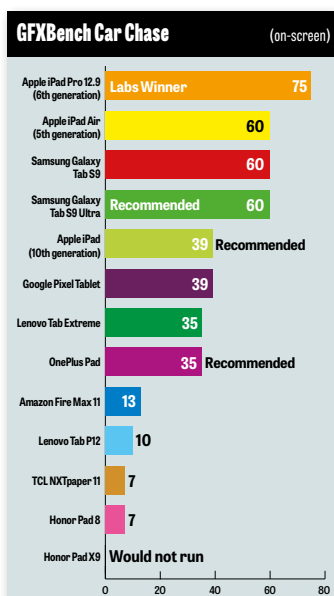
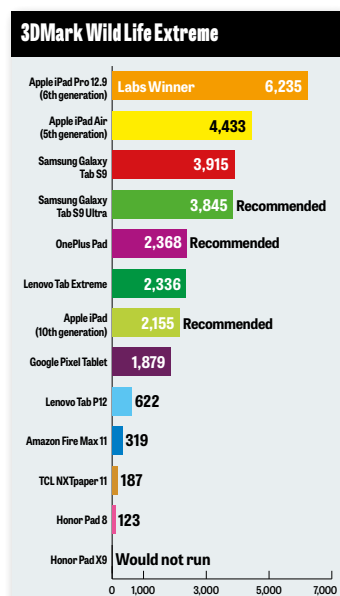
Finally, our battery rundown test repeatedly plays a 1080p video file with the brightness of the displays set to 170cd/m<sup>2</sup>. We then measure how much they recharge to after 30 minutes.

We also used each tablet for a mix of web browsing, video streaming, office work and gaming, to see how they measure up in real-world use.

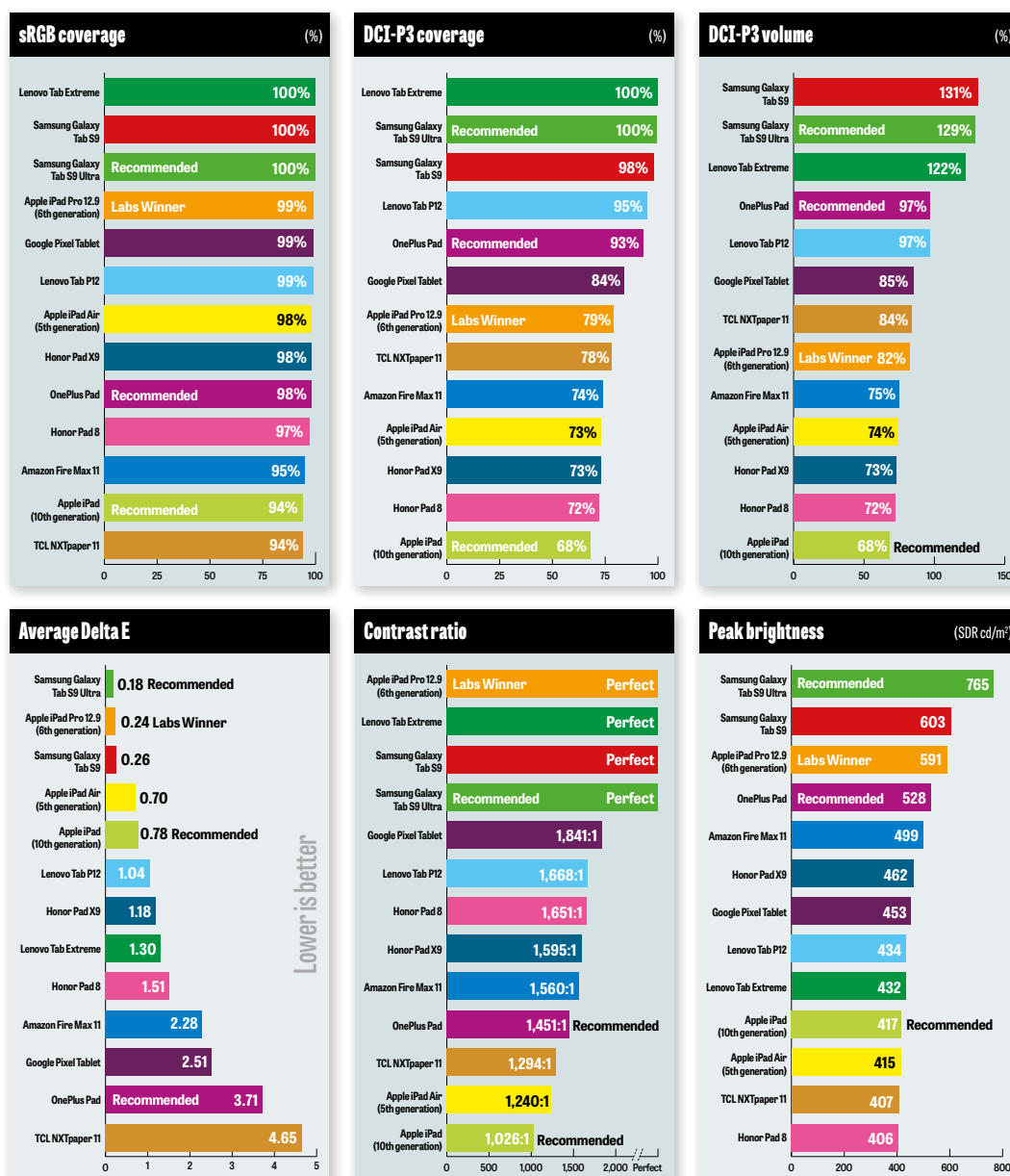
## Speed tests



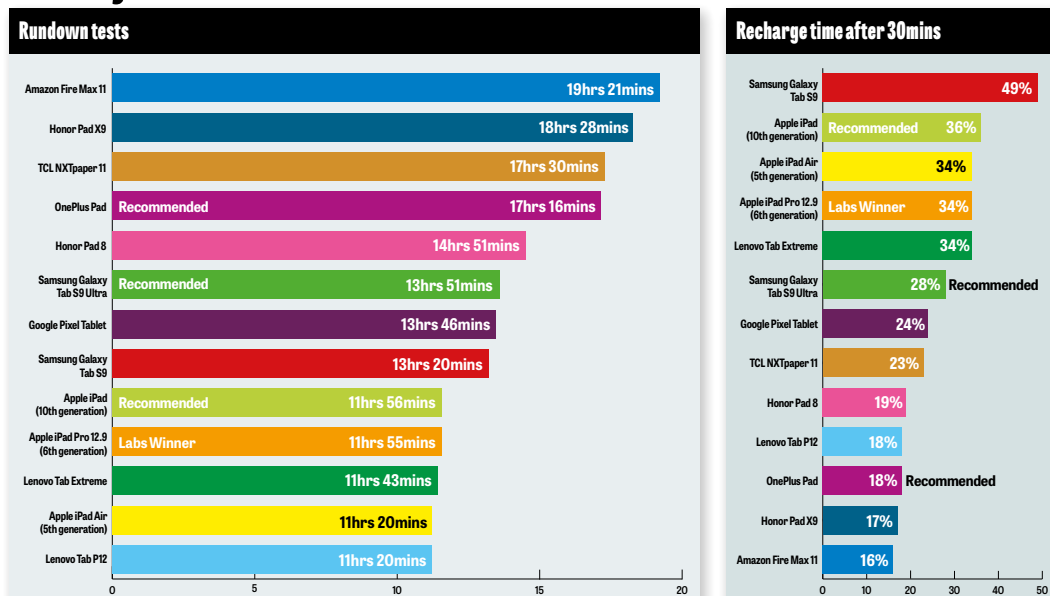
## 3D tests



## Screen tests



## Battery tests



## View from the Labs

A sleek, shiny body simply isn't enough

If there's one takeaway from this month's Labs, it's that even as the tablet hardware gets better it's increasingly the ecosystem that makes the most tangible difference.

When I started reviewing tablets around 12 years ago, there was a huge gulf in quality between Apple's hardware and everybody else's. The Android competition was heavier, uglier and slower, with woeful low-resolution screens and limited processing power the norm. That's no longer true. Metallic shells and unibody constructions are standard, and it's rare to find anything without a decent screen.

There's good news on the software front as well. With a little help from Google, more Android manufacturers provide proper split-screen and floating window support, and UIs built with tablets in mind. It's still frustrating to see so many iPad apps unavailable on Android, but there are enough creative and productivity apps to meet most requirements.

Yet it's the ecosystem that really matters: having the hardware, software, peripherals and services in place to make a tablet a serious business or creative tool. Apple and Samsung lead the way with their keyboard and stylus options, and Lenovo isn't far behind. Amazon is heading in the right direction, but FireOS doesn't feel primed for productivity or art, while its app store still lacks key apps.

Of the others, it's newcomer OnePlus that seems to best understand that just having a big screen and a keyboard case available doesn't cut it; you need a UI that's flexible enough to support real multitasking, and access to the apps and services you need to get to work. That's worth paying the extra for, and it's also what keeps Apple and Samsung at the very top. ●



Stuart Andrews is a former reviews editor of PC Pro and a long-time tablet addict

# The Network

Practical buying and strategic advice for IT managers and decision makers

## Buyer's guide

# Video conferencing system

The right videoconferencing kit will help knit on-site and remote teams together, as well as helping meetings with clients. Dave Mitchell reveals what to look for

**V**ideoconferencing (VC) is now woven into the fabric of every modern business. Since the pandemic, forward-thinking companies have seen the clear benefits of remote and flexible working, making VC an indispensable tool for communication and collaboration across the globe.

This demand has pushed VC kit manufacturers to be more innovative, resulting in an impressive choice of sophisticated meeting room solutions. Intense competition has also pushed down prices, bringing professional audio/visual huddle, meeting and conference room solutions well within the reach of SMBs.

All-in-one VC room bars are ideal for businesses with smaller meeting spaces as they're easy to install and use. SMBs with much larger rooms may want to consider a kit solution with separate camera, speaker and microphone components that can be deployed to cover bigger spaces without any degradation in quality.

### ■ All together now

All-in-one video bars are a great choice for smaller businesses that want to set up a dedicated meeting room with the minimum of fuss. The best ones combine a high-quality 4K UHD camera with integral speakers and microphone arrays so all you need to do is decide where to mount them.

Cable clutter is reduced, since most video bars only require power, a USB cable and a wired or wireless network connection. The only other component you'll need to factor in is a meeting room monitor. Adding a 4K model will future-proof your meeting room, but with so few unified communications (UC) apps supporting end-to-end 4K

meetings, you'll be just as well served with a good-quality 1080p monitor.

There are generally two types of video bar, with host-based models designed to be connected to a PC or laptop over a USB cable so they can directly access their camera, speakers and microphones. Users can bring their own device to the room and run their preferred UC app, but for extra convenience you can set it up with a dedicated room computer so it's always ready for use.

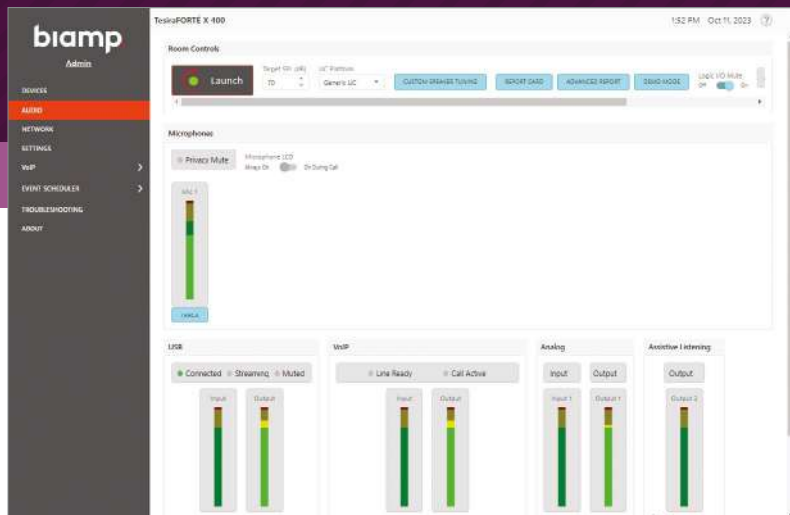
Standalone VC bars don't require a host computer as they run an embedded OS, such as Android, allowing them to host a range of certified on-board meeting apps such as Microsoft Teams and Zoom Rooms.

Users don't need to bring anything with them and can start a meeting with a few taps using the onscreen menus or optional touchscreen control tablets.

For extra flexibility, look for room bars that support host and standalone modes; two products on review swap seamlessly between

**BELOW** Biamp's DSP appliance provides PoE+ for the kit components





**LEFT** Biamp Launch automatically configures the kit for you

is located and focus the camera on them. By identifying and zooming in on the active speaker, they make meetings more dynamic (and impressive) and ensure that all participants are focused only on them.

For the best speaker-tracking performance we recommend room bars and cameras that use digital pan, tilt and zoom (PTZ) functions. These are a lot quicker to respond to movement than products that use motorised PTZ, and all the systems on test are able to snap to the active speaker in only a couple of seconds.

Ceiling array microphones go further as they can automatically separate the audio space below them into distinct zones. As the speaker moves around the meeting room, they adjust their directional pickups to ensure they're clearly heard, with some offering facilities to declare "dead zones" where you don't want sound picked up from.

Another feature that makes meetings even more immersive is



**LEFT** The Epos Control tablet connects to its Vision 5 video bar for simple one-tap meetings

them by detecting when a USB connection has been made. It makes sense for a company to standardise on one UC platform for its employees, but if you're working with external clients and customers, dual-mode systems can work with their preferred apps rather than forcing them to use yours.

## Go for separation

Video bars are great for small and medium-sized meeting rooms, but their limited speaker and microphone ranges make them less suited to much larger spaces. The comparatively small speakers in their enclosures can also impact on audio quality, which often deteriorates as volume levels are increased.

Businesses planning dedicated meeting rooms hosting a large number of participants should consider solutions comprising separate components as these are far more flexible. You'll probably need them installed by professional fitters, but many larger vendors offer complete kits comprising powerful ceiling speakers, table or ceiling microphones, digital signal processor control units

to join them together and all required cabling.

For the tidiest installations, look for kits that provide Power over Ethernet (PoE) services, allowing each component to be powered by standard Cat5e network cables. The kit in this buyer's guide provides all the audio components for a large room with up to 11 participants, presents full 30W PoE+ services and can be teamed up with the video camera and room monitor of your choice.

## Walk this way

Stuffy meetings where everyone stayed glued to their chairs are a thing of the past. The latest room bars and kit microphones provide smart tracking and framing features so if you want to stretch your legs and look completely casual, they'll follow you around the room.

They generally use multiple internal microphones, called beamforming or beamtracking arrays, to pinpoint where the person speaking



**ABOVE** Meeting participants are always in view with the Owl Bar and Meeting Owl 3

split-screen technology. One of the video bars in this guide can team up with the same vendor's desktop unit to present a 360° panoramic view across the top, with the three most recent speakers below, and dynamically choose the best view to ensure all speakers are always looking directly at you.

Videoconferencing and meeting rooms are the way forward for businesses committed to flexible working, and there are many sophisticated products that are very affordable options for SMBs. In the following pages, we've reviewed all-in-one and component solutions, so read on to see which one best fits your new virtual workspaces.



## Biamp MRB-M-X400-T

A highly flexible professional meeting room solution that's easy to install and delivers outstanding audio quality

SCORE ★★★★★

PRICE Kit and Vidi 250, £7,718 exc VAT (RRP) from midwich.com

**B**iamp recently made a splash in the video bar market with its stunningly good Parlé VBC 2500 (see issue 347, p102), but its main focus has always been the professional audio-visual (AV) space. It has a solution for every room size, with the MRB-M-X400-T kit on review providing all the audio components for a medium-sized meeting room with up to 11 participants.

The Biamp kit comprises a TesiraFORTÉ X 400 digital signal processor (DSP) unit, a Tesira AMP-450BP speaker amplifier, a Parlé TTM-X beamtracking table microphone with expansion box, two Desono C-IC6 ceiling speakers and plenty of plenum-rated Cat5e cabling to connect it all together. Biamp has its own range of VC cameras and supplied us with the Vidi 250, which has a 120° field of view (FoV) and digital pan, tilt and zoom (PTZ) functions.

A full room installation will need to be done by professional fitters, but we had a basic configuration created in the lab in an hour. A handy feature is that power only needs to be



**ABOVE** The Vidi 250 camera delivers great video quality



supplied to the DSP unit as its four gigabit ports deliver 30W PoE+ services over Cat5e cables to all other components. The low-profile speakers will fit in most drop ceiling spaces and their 130° coverage is designed to accommodate low ceilings. The AMP-450BP amplifier unit can be concealed in the ceiling using the speaker's "backpack" brackets, and it has four RJ-45 ports so you can add two more speakers.

There's no need to worry about sound configuration, as Biamp's Launch process does it all for you. Press the Launch button on the DSP unit and the system measures the meeting room's acoustics by emitting a series of eerie sounds that reminded us of the 1956 *Forbidden Planet* sci-fi movie.



**LEFT** The Biamp kit provides everything you need for a medium-sized meeting room

**"The speakers also receive our accolades for their exceptional sound quality, natural-sounding voices and warm bass"**

**LEFT** Expect excellent sound and vision, all easily managed by the DSP appliance

The DSP analyses the audio feedback, configures all the components to your environment and presents a Launch report card in its local web interface. The bottom line is that you may need help fitting the kit but you won't need an audio expert to fine-tune it.

For the full audio/visual meeting experience the simplest solution is to connect the DSP's USB port to a room PC with a Full HD monitor where the mic and speakers appear as speakerphone devices. Add the Vidi 250 camera to the host as a separate USB device and it will use its integral auto-framing functions.

The camera reacts quickly with delays of no more than three seconds as it tracked speakers moving around our meeting room. Video quality is great, with the camera presenting a sharply focused image and efficient backlight compensation.

The microphone's beamtracking technology uses four 90° zones to track voices and allow speakers to roam freely but still be heard clearly. In practice, this works extremely well, and the speakers also receive our accolades for their exceptional sound quality, natural-sounding voices and warm bass.

Another scenario is to connect the kit to a UC compute device, and for this Biamp provided Lenovo's ThinkSmart Core+ Control product. Just plug in the DSP and camera to its USB ports, add an external monitor, connect the Control tablet and you're ready to go.

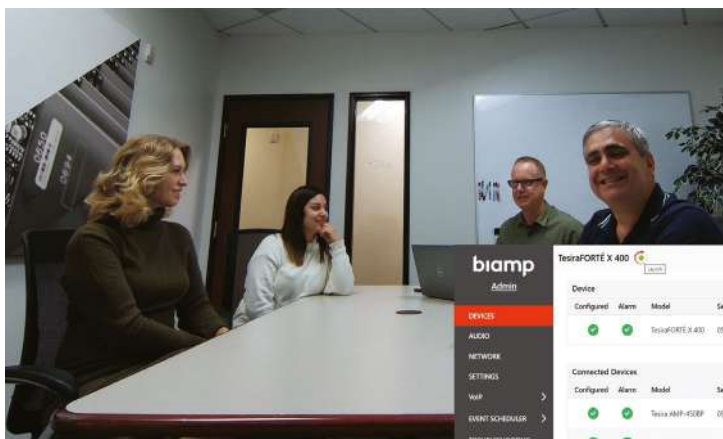
It runs Windows 10 IoT and we used its setup wizard to select Teams operations (Skype for Business is also supported). After logging

into our Microsoft 365 account it appeared as a Teams Rooms on Windows device and we could use the tablet to swiftly schedule and join meetings.

The Biamp MRB-M-X400-T is a great choice for businesses that want to transform their meeting room into a professional conferencing space. All the components are surprisingly easy to deploy, Biamp's Launch feature provides slick automated room configuration and the Vidi camera delivers great video quality.

### SPECIFICATIONS

Vidi 250 4K UHD camera • 120° FoV • digital PTZ with 5x zoom • TesiraFORTÉ X 400 DSP, external PSU, 5 x gigabit (WAN, 4 x PoE+) • Tesira AMP-450BP speaker amp • Parlé TTM-X beam-tracking table mike • 2 x Desono 60W C-IC6 ceiling speakers • 2 x 7.5m and 2 x 3m Cat5e plenum cables • 5yr hardware warranty



## Epos Expand Vision 5 Bundle

This good-value VC combo offers slick on-demand Teams Rooms and BYOD modes and great image quality

SCORE ★★★★★

PRICE £1,915 exc VAT  
from [misco.co.uk](https://www.misco.co.uk)

**S**MBs invested in Microsoft Teams and looking to improve their employees' meeting room experience will find the Epos Expand Vision 5 Bundle a worthy contender. This well-specified room bar solution can swap between Android-powered Microsoft Teams Rooms and bring your own device (BYOD) modes in seconds, while the Expand Control touchscreen tablet provides easy meeting management.

The Vision 5 video bar provides a solid foundation with its combination of a Sony 4K UHD camera and wide 110° horizontal field of view (FoV), dual speakers and quad beamforming MEMS microphones. It employs digital pan, tilt and zoom (PTZ) functions for automated framing and speaker tracking, while noise reduction is handled by its integral Epos AI feature.

An embedded 8-core Qualcomm 800-series Snapdragon CPU plus 4GB of memory look after the certified Microsoft Teams Rooms on Android app. Also certified for Teams Rooms, the Expand Control tablet sports a large 10.1in colour LCD touchscreen and uses its embedded 6-core ARM CPU and 4GB of memory to run the Android OS.

Setup is a smooth process, but you should first decide whether you want to run your Epos kit as a locally

managed system or add it to the free Epos Manager on-premises or cloud service. Larger businesses will prefer Epos Manager as it provides company-wide status views of all their registered Epos devices, along with central management, firmware updates and extensive device and room usage analytics.

The Expand Control tablet requires a network connection with a power over Ethernet (PoE) source. From its onscreen wizard, we used the unique code it generated to assign it to our Microsoft 365 account, where it appeared in our Teams admin interface as a touch console.

After networking the Vision 5 over Ethernet or Wi-Fi 5, you follow the same registration process. Once it appears as a new Teams Rooms on Android device, you pair it with the tablet using the 6-digit code it presents on the camera's screen. Our Teams admin console showed both devices as online and confirmed that the touch console was paired, after which the tablet shifted all Teams meeting controls from the camera's screen to its own display.

We had no problems creating and joining Teams meetings using the tablet's touchscreen, and remote participants thought that the camera's video quality was

**ABOVE** The Vision 5 video bar has a Sony 4K UHD camera



**"Tracking worked well, with the camera taking no more than a couple of seconds to locate the active speaker"**

**BELOW** The Expand Control tablet makes meeting management easy

excellent. The image is sharply focused and we noted that Epos has improved its backlight compensation feature.

Tracking worked well, with the camera taking no more than a couple of seconds to locate the active speaker and smoothly follow them as they moved around the meeting room. The twin speakers were found wanting in the bass department, but voices are clear and we found a volume level of 80% was enough to fill our 24m<sup>2</sup> meeting room.

During the pairing process all camera controls are ported over to the tablet. The intelligent framing feature can be enabled or disabled, and in manual mode the camera places a video view over its Teams interface so you can use a combination of 4x digital zoom and mechanical pan/tilt to move it to the required position.

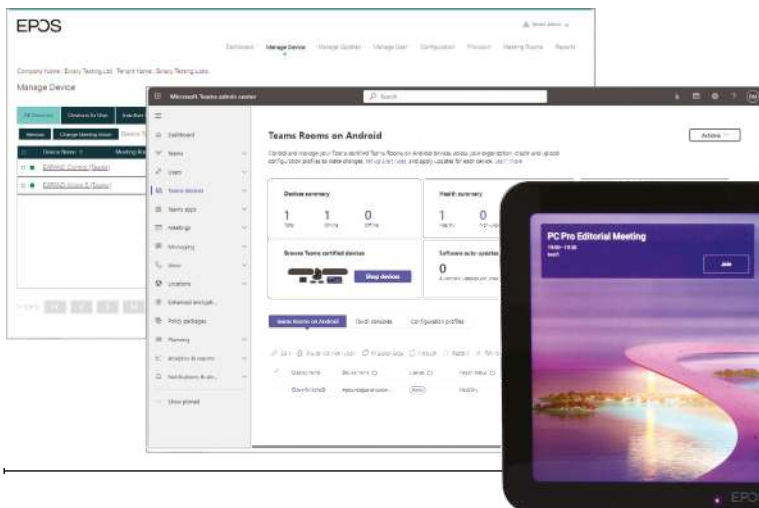
A smart feature is the video bar's ability to swap effortlessly between Teams and USB host modes. The process is automatic as the Vision 5 swapped to host mode when it sensed a USB connection and returned to Teams automatically when we removed the cable.

The Expand Vision 5 Bundle is a great choice for SMBs seeking an affordable Microsoft Teams Rooms solution with seamless BYOD support. Video and audio quality is good, speaker tracking is smooth and the Control tablet makes meeting room management a breeze.

### SPECIFICATIONS

Sony 4K UHD camera • 110° FoV • 1080p • Android 10 • 4x digital zoom • 2x speakers, 4x MEMS mics • gigabit Ethernet • Wi-Fi 5 • Bluetooth 5 • HDMI in/out • USB-C • external PSU • 620 x 115 x 74mm (WDH) • 2.5kg • 2yr limited warranty. **Expand Control:** 10.1in colour touchscreen • 10/100 802.3af PoE

**LEFT** Epos Manager provides cloud management





## Logitech Rally Bar Huddle

A smart all-in-one VC solution for small meeting rooms with a choice of operating modes

SCORE ★★★★★

PRICE £1,799 exc VAT  
from [meetingstore.co.uk](https://www.meetingstore.co.uk)

Logitech's traditional Rally Bar videoconferencing (VC) room solutions offer an incredible range of features, but smaller businesses may be put off by their size. Enter the Rally Bar Huddle, which steps in below the Mini model (see issue 340, p97), and is designed for meeting rooms of up to six participants.

Width-wise, the Huddle is 170mm shorter than the Mini and weighs less than half as much. Its 4K UHD camera dispenses with the motorised pan, tilt and zoom (PTZ) functions used by its bigger brothers and goes fully digital.

There's room for Logitech's standard six-microphone beamforming array for auto-framing of active participants, while audio output is handled by a single downward-firing ported speaker. The graphite fabric magnetic front cover can be swapped out for an off-white fabric version for £109 or a white plastic cleanable cover, which costs £129.

As with Logitech's other Rally Bars, the Huddle supports three operational modes, and you can connect it to a dedicated room computer or let users bring their own device (BYOD) and load the VC app of their choice. In appliance mode, Logitech's on-board Android-based CollabOS turns the Huddle into a standalone system, with it

currently supporting Microsoft Teams Rooms and Zoom Rooms.

Deployment is smooth. After connecting the Huddle's gigabit network port (Wi-Fi 5 is also available) we used its web interface to choose BYOD, Teams or Zoom mode. We could access all audio and video settings, run firmware upgrades and enable Logitech's RightSight 2 video enhancement technology, although only the Group view was available, with the Speaker and Grid views yet to be implemented.

Load Logitech's Sync app on the host PC and you can add the Huddle to a Sync cloud account for remote management of all your Logitech room devices and room usage analytics. The Huddle also supports Logitech's optional Tap IP and Scheduler touchscreen tablets.

BYOD mode is easy to use: we connected a Windows 10 host PC to the camera's HDMI-in port and an HD monitor to its HDMI-out port and used our local Teams, Skype and Zoom VC apps. Configuring the Huddle in appliance mode is equally swift. We chose Teams from the web console and, after a reboot, used the unique code it presented to assign it to our Microsoft 365 account. The Huddle duly appeared in our Teams admin console as a new Teams Rooms on Android

**ABOVE** The 4K UHD camera uses digital pan, tilt and zoom

**"The camera delivers a sharply focused image with good colour balance, and its backlight compensation works very well"**

**LEFT** The Huddle can be cloud managed and supports three operating modes

device, while our attached Full HD monitor presented the familiar Microsoft Teams interface.

Connect a PC over USB and the Huddle will swap to BYOD mode and back to Teams when you remove the cable, although we noted that in Teams mode the web console was disabled and returning the Huddle to BYOD-only mode requires it to be reset to defaults.

The camera delivers a sharply focused image with good colour balance, and its backlight compensation works very well.

Sound quality from the single speaker is easily good enough for small meeting rooms, and we liked the Huddle's motorised privacy shutter, which automatically closes

when a meeting has finished.

The Huddle's digital PTZ speaker tracking is much faster than Logitech's other Rally Bars, which can often take up to eight seconds to respond to movement. During a Teams meeting, we wandered around our room as we spoke and the camera smoothly tracked us with delays of no more than three seconds.

Some features are yet to be added, but Logitech's Rally Bar Huddle is a good choice for small businesses with equally small meeting rooms. Speaker tracking is the fastest of all the available Rally Bars, audio and video quality are good, and Logitech's integral CollabOS adds extra versatility.

### SPECIFICATIONS

4K UHD camera • max 1080p • 120° FoV • digital PTZ (4x zoom) • 6 x beamforming microphones • 55mm 8W ported speaker • gigabit Ethernet • Wi-Fi 5 • HDMI-out, HDMI-in • 2 x USB-A 3.2 Gen 1 • external PSU • 550 x 76 x 79mm (WDH) • 1.8kg • 2yr hardware warranty



## Owl Labs Owl Bar

A well-featured VC room bar, and pairing it with an Owl 3 turns mundane meetings into memorable ones

SCORE ★★★★★

PRICE £1,999 exc VAT  
from [owllabs.co.uk](https://www.owllabs.co.uk)

At first glance the Owl Bar looks unremarkable, but it has some neat tricks up its sleeve that make it stand out from the crowd of videoconferencing room bar solutions. It will work happily as a standalone VC device, but pairing it with the Owl Labs Meeting Owl 3 desktop unit delivers all-inclusive meetings.

An annoying issue with meetings is when people around the desk talk among themselves and remote participants see only the side or back of their heads, making them feel excluded. The Owl Bar provides a front-of-room view, and placing an Owl 3 in the centre of the table brings its smart 360° panoramic and dynamic split-screen views into play.

The Owl Bar has good credentials, teaming up its 4K UHD camera with a four-microphone array, a large single speaker and digital pan, tilt and zoom (PTZ) functions for speaker tracking. The powerful Qualcomm 8-core SoC adds extra intelligence as it can also track speakers by recognising the shape of their heads.

Installation is a breeze: after we connected the Owl Bar to a Windows 10 Pro desktop PC, it loaded all required drivers (note that the HDMI ports are currently reserved for future use). The easiest way to manage the Owl Bar is via the mobile apps, and we had no problems with the iOS version on an iPad.

It connected to the Owl Bar over Bluetooth and ran through naming it,

linking it to the network using a wired or Wi-Fi 5 connection and checking for firmware updates. We also registered it with our Owl Nest cloud portal account, which provides remote status views of all Owl devices plus options to configure default camera behaviour, load meeting analytics and run firmware upgrades.

The Owl Bar worked fine on our Teams and Zoom meetings, with its camera delivering a good-quality, sharply focused image. The single speaker produces clean sound with a warm bass and enough punch to cover our 24m<sup>2</sup> meeting room. The mics also worked well as remote participants said they could hear us clearly.



**ABOVE** The Owl Bar has a number of tricks up its plain-looking sleeve

**“The entire process is seamless as the Owl Bar and Owl 3 team use their algorithms to automatically choose the best view”**

**LEFT** The Owl 3 provides a 360° panoramic view of participants

**BELOW** Everything can be managed easily from the mobile app

The Owl Bar's sound and vision tracking combo works extremely well. We could walk around our meeting room and, even without speaking, the camera smoothly tracked our face while we were moving.

For the pairing process, we used the iOS app to add our Owl 3 as a secondary device. They can be quite

picky as the silver logos on each unit must face each other with no obstructions on the table blocking the line of sight of their pairing LEDs.

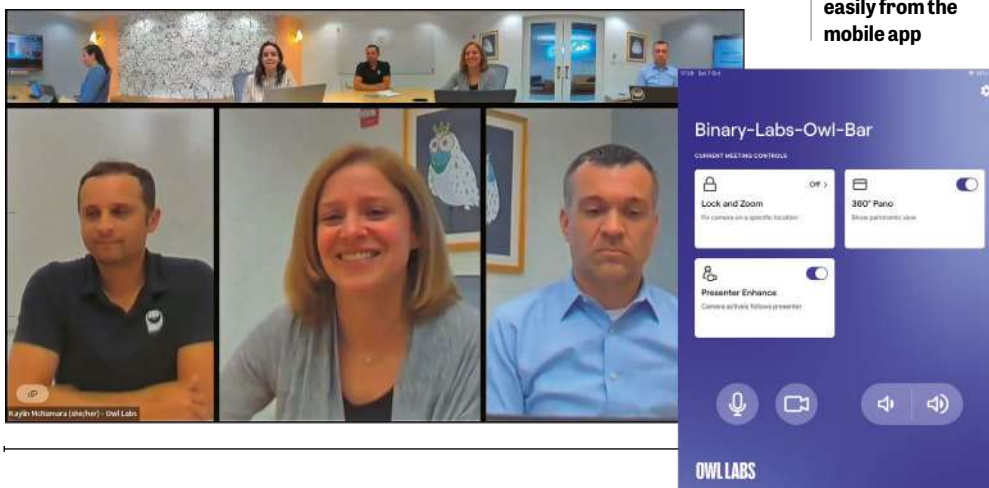
The Owl Bar's camera view provides icons in the lower left-hand corner showing pairing status and whether presenter tracking is enabled. Turn on the 360° Pano view from the local Windows Owl utility or mobile app and prepare to be amazed, as the view changes to a panoramic view across the top with the main view below dynamically splitting into three windows showing the most recent speakers and the person currently speaking.

The entire process is seamless as the Owl Bar and Owl 3 team use their algorithms to automatically choose the best view. If speakers turn away from the Owl Bar, the Owl 3 steps in with its all-seeing eye and changes the view so they're looking directly at you – it's that simple.

As a standalone VC room solution the Owl Bar has plenty to offer, with good video quality and super-smooth speaker tracking. It really comes into its own when paired with an Owl 3, though, as this unleashes a completely new dimension to your meetings.

### SPECIFICATIONS

4K UHD 30MP camera • max 1080p • 114° FoV • digital PTZ • 8-core Qualcomm 8250 SoC • 4 x omnidirectional mics • speaker • gigabit Ethernet • Wi-Fi 5 • 2 x HDMI-out, HDMI-in • 2 x USB-A 3.2 Gen 1 (A/C) • external PSU • 769 x 97 x 76mm (WDH) • 2.6kg • 2yr limited hardware warranty. **Options:** Owl Bar and Meeting Owl 3 bundle, £2,999 exc VAT



# Allied Telesis

## AT-AR4050S-5G

A few rough edges, but this gateway appliance delivers lots of security features and dual-SIM 5G failover services

**SCORE** ★★★★★

**PRICE** Appliance with base licence, £1,618 exc VAT from [lambda-tek.com](http://lambda-tek.com)

The AT-AR4050S-5G from Allied Telesis targets SMBs and remote offices seeking a single solution that combines tough network perimeter security with total WAN redundancy. This desktop firewall appliance sports dual 5G SIM slots and offers WAN failover services for businesses that cannot tolerate any internet downtime.

You can add two 5G SIMs, which are automatically configured as primary and backup mobile network connections, and the appliance supports cards from different carriers. You can also use one of the appliance's wired WAN ports as the primary internet link and back it up with a 5G connection.

The appliance teams up its dual gigabit WAN ports with an eight-port gigabit network switch for LAN systems. It has plenty of power on tap, with its quad-core 1.5GHz CPU claiming a maximum raw firewall throughput of 1.9Gbits/sec, dropping to 750Mbps/sec with the intrusion prevention service (IPS) enabled.

The appliance's base licence enables an SPI firewall with deep packet inspection and includes IPS,

web filtering, built-in application controls, bandwidth management and support for IPsec and SSL VPNs. Free central management of five Allied Telesis TQ series of wireless access points is included, with a feature licence extending this to 25.

Two optional security licences are available, but you can only choose one as they can't be run together. An advanced firewall option activates more extensive application and web controls, while the advanced threat protection version adds tougher IPS and IP reputation services, with each costing £521 per year.

Our system came with a Vodafone 5G SIM and we used this as the backup connection with the first gigabit WAN port providing the primary connection. Deployment is simple: the appliance's browser interface provides a quick-start wizard that runs through choosing the primary WAN connection and assigning a DHCP server to the default LAN subnet.

In dual 5G SIM deployments, you set a failover interval in seconds for the primary SIM and, if it fails, the appliance automatically swaps over to the backup SIM. To test wired WAN redundancy, we removed the network cable but found the backup SIM would only step in after the appliance was

rebooted, although we did note that after reconnecting the network cable it reverted back to this without any intervention.

The web console's widget-based dashboard shows a graphic of the appliance along with tables and graphs for traffic activity, appliance hardware utilisation, security service activity and the top applications. A minor complaint is that the graphic only shows active LAN ports and doesn't highlight which Ethernet WAN ports and SIM slots are active.

The appliance uses entities to define a logical map of the network, which can be zones, networks and clients. Top-level zones describe boundaries such as the WAN, LAN and DMZ, with each containing networks of IP subnets and addresses while clients are individual systems.

These come into play when you create firewall rules as they comprise a source and destination entity and an action that blocks or permits traffic between them. You can also add rules to manage bandwidth usage for specific applications and assign them to entities.

The advanced threat protection licence enables IP reputation lists and stronger IPS courtesy of ProofPoint's ET-Pro ruleset. The web console has options for anti-malware and antivirus, but we were advised

**ABOVE** The appliance has two gigabit WAN ports and an eight-port gigabit network switch

**"The AT-AR4050S-5G neatly integrates advanced network perimeter security with redundant 5G mobile connections"**

that these Kaspersky-managed services are no longer available.

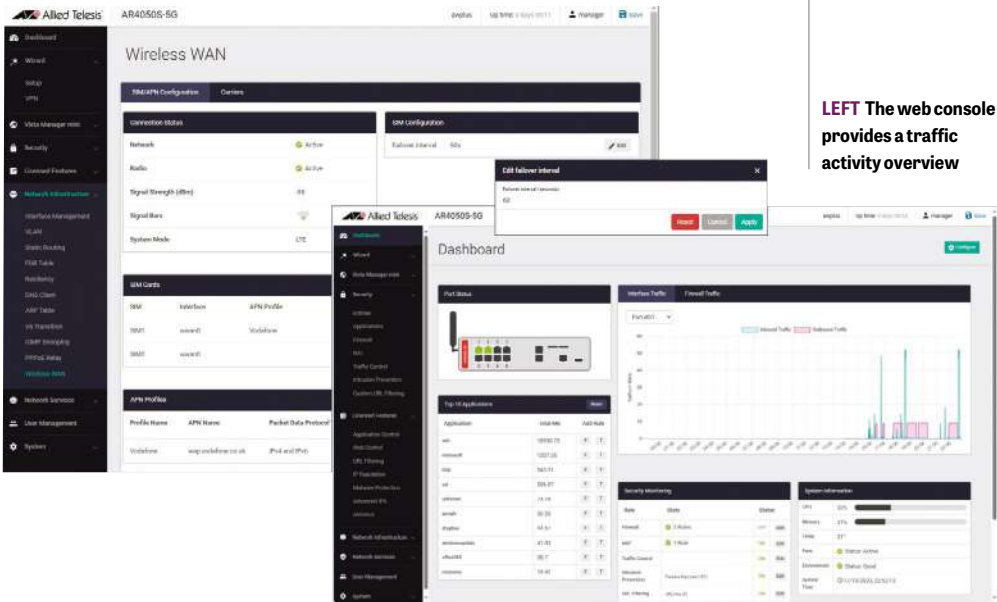
The built-in application library contains around 200 signatures, and the advanced firewall licence

activates the Procera app visibility library, which increases the signature count to nearly 2,000. Likewise with URL filtering, as the integral OpenText list can be upgraded to the Digital Arts service which offers around 100 web categories.

The AT-AR4050S-5G neatly integrates advanced network perimeter security with redundant 5G mobile connections. Failover for wired WAN connections isn't perfect and some security features are no longer available, but this appliance will appeal to businesses and remote offices in rural areas with limited broadband services, and it's offered at a very competitive price. **DAVE MITCHELL**

**SPECIFICATIONS**

Desktop chassis • quad-core 1.5GHz CPU • 2GB RAM • 4GB flash storage • 8 x gigabit LAN switch • 2 x gigabit WAN, 2 x 5G SIM slots • 4 x external aerials • USB-A 3.2 Gen 1 • RJ-45 console port • internal PSU • 220 x 260 x 43mm (WDH) • web browser management • 1yr hardware warranty



**LEFT** The web console provides a traffic activity overview

# QNAP Thunderbolt NAS

## A creator's paradise

As creative work becomes more demanding, you need a storage system to match your ambitions

**C**reators and content editors need plenty of storage – and they need it to be lightning-fast. An ordinary NAS appliance won't do, as the network connection is too slow for working with 4K video or large multimedia files.

QNAP's new TVS-h874T is the ideal solution. It features the latest Thunderbolt 4 technology, allowing power users to connect directly to the NAS at speeds of up to 20Gbits/sec. That means creators can edit and process full-bit rate video in situ with no delays or slowdowns, while the rest of the workgroup maintains shared access over a traditional Ethernet link.

### ■ Live collaboration – seamlessly

The TVS-h874T is great for teamwork, too. It's officially supported as a collaboration platform for Adobe Premiere Pro and Da Vinci Resolve Studio, allowing two users to work together over twin Thunderbolt connections. The appliance also includes its own HDMI output for direct media display, and on-device viewing is just as easy, thanks to the built-in Intel UHD Graphics 770 GPU, which handles video streaming.

Alternatively, the second Thunderbolt port can be used to connect additional peripherals in a daisy-chain configuration, for convenient access over a single cable. Three 10Gbits/sec USB-A ports allow for the easy connection of cameras and external storage devices, with a one-touch copy button to quickly import all files from a connected device.

For network access, the TVS-h874T's embedded 2.5Gbits/sec Ethernet controller allows all users to enjoy the performance of a multi-gigabit network connection. For even faster access you can install one of QNAP's expansion cards to provide 10GbE or even 25GbE connectivity, offering enough bandwidth for the whole team to work with video in real-time.

### ■ Huge capacity with built-in data protection

The TVS-h874T has all the capacity you need for large-scale multimedia projects. Its eight front-facing drive bays can house a massive 154TB of storage in a fault-tolerant RAID5



**BELOW** QNAP's new TVS-h874T offers creators and content editors lightning-fast storage

configuration, and additional enclosures can be added for a maximum capacity of 396TB. A pair of internal M.2 SSD slots allow you to install a mirrored NVMe cache for peak performance.

No matter how much data you're working with, it's all kept safe from corruption and degradation by the QuTS Hero operating system. QNAP's self-healing data feature detects and silently corrects transient errors, while triple-parity and triple-mirroring RAID options provide maximum protection against disk failure. If you're using SSDs, the system will automatically monitor the health of your drives and warn you if there's a chance of an upcoming failure.

### ■ Professional apps and more

Like every QNAP NAS, the TVS-h874T includes a full suite of professional collaboration tools. Qsync works as your own private cloud, allowing you to easily share and synchronise project files with any number of computers and mobile

devices, while Qsirch lets you instantly search your storage to locate documents of any type.

The powerful Qfiling tool makes light work of organising imported

footage and other items, automatically categorising and sorting files into the correct folders and applying optional processing such as resizing, transcoding and encryption.

QNAP's App Center offers dozens more powerful apps to download, including native and third-party backup services, IP camera management and network security tools.

### ■ Power to spare

The TVS-h874T eats up heavy workloads, thanks to a 12th-generation processor and up to 64GB of RAM. Indeed, the Intel Core i7 or Core i9 TVS-h874T is a certified virtualisation platform for Citrix, VMware, Microsoft Hyper-V and Veeam, so you can use it to run more or less any service you wish. Install your choice of guest OS and gain the benefits of a powerful CPU, massive storage and lightning-fast connectivity, without the cost and management burden of physical servers.

With ultra-fast file access over Thunderbolt, industry-standard collaboration features and a host of office productivity and back-end capabilities, the QNAP TVS-h874T NAS is the complete package for busy creative studios and production offices.

Find out more at [www.qnap.com](http://www.qnap.com)

**RIGHT** The TVS-h874T's eight front-facing drive bays can house a massive 154TB of storage



## Firewalla Gold SE

This multi-gigabit firewall appliance is small in stature and big on security features and value

SCORE ★★★★★

PRICE \$449 (around £370) from [firewalla.com](https://firewalla.com)

**F**irewalla has a fine reputation for delivering highly affordable firewall appliances, and its Gold SE goes to the top of the class. Aimed at home workers and small business networks, it provides future-proofing for gradual increases in broadband speeds as it comes with a 2.5GbE multi-gigabit WAN port.

Costing \$449 (around £370), the Gold SE is a winner for both value and features, as this minuscule fan-less desktop unit offers three LAN ports, with the first one also of the 2.5GbE variety. There are no compromises on internal hardware, either, with a speedy 2GHz quad-core ARM Cortex-A55 CPU teamed up with 4GB of DDR4 and a 32GB SSD for internal storage.

The Gold SE supports plenty of deployment scenarios and in the recommended router mode, you simply drop it in between your ISP device and network. Firewalla's optional Wi-Fi SD USB adapter adds extra redundancy as it can automatically connect to your phone or nearby Wi-Fi 5 hotspot if the primary internet connection fails.

Deployment is undemanding. We used Firewalla's iOS app to link an iPad to the appliance's USB security dongle for Bluetooth pairing and activation. A wizard guided us through the setup process, which included selecting Google Meet, MS

Teams, Webex or Zoom for Smart Queue traffic prioritisation and enabling Active Protect for blocking malicious activities and sending alerts.

At this stage, you can leave the appliance to get on with protecting your network as most security features are enabled by default. A base firewall rule for inbound traffic inspection is applied, Active Protect enables IDS and IPS with a predefined rule bundle, and Ad Block defaults to strict mode.

It's easily customised, too. The Family option filters out undesirable websites, and you can place the network ports in different groups each with their own set of rules. Targets can be an IP address or range, a domain, a country, local or remote ports, a choice of popular apps or a group of web categories such as games and rules can be assigned to all devices or selected ones.

The New Device Quarantine feature is enabled with one swipe in the mobile app and deftly handles rogue devices. When it spots a new MAC address, it places it in a quarantine group with two default rules blocking LAN and internet access so you can evaluate its security posture at your leisure and decide whether to release it.

The mobile app provides full access to all security services, including facilities to create VPNs for remote

**ABOVE** The tiny desktop unit offers three LAN ports, one of which is 2.5GbE



**"It provides future-proofing for increases in broadband speeds as it comes with a 2.5GbE multi-gigabit WAN port"**

**LEFT** The Gold SE is easily managed from Firewalla's mobile app and cloud portal

workers. It presents a wealth of information on network performance and detected devices, with traffic flows revealing app usage, top upload and download destinations plus all blocked activities.

Choose a device and you can drill down to see its traffic activity and blocking actions. Pop-up notifications spill the beans on what the user is doing and, cleverly, with one tap you can block internet access or deny access to web categories such as games and videos or stop the user accessing popular services such as YouTube, TikTok, Facebook, Twitter/X, Netflix and Snapchat.

Remote appliance management comes courtesy of Firewalla's cloud-hosted MSP portal, with the free personal plan supporting one appliance. Adding our Gold SE was a cinch: we accessed the portal from the [my.firewalla.com](https://my.firewalla.com) URL and used the mobile app to scan the QR code it

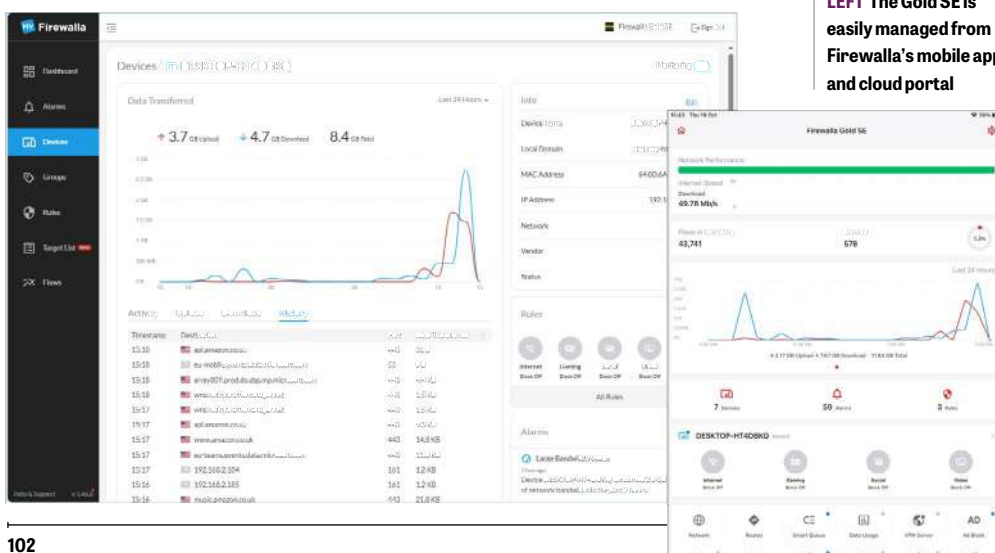
presented to add the appliance.

It's just as informative as the mobile app, with its dashboard revealing everything you need to know about user activity. It also provides access for creating groups and custom rules, applying blocking actions to devices and adding custom target lists for use in rules.

The Firewalla Gold SE is a great choice for protecting small networks, delivering tough perimeter security at an incredibly low price. You don't need to worry about ongoing costs, either, as the price includes all security services, lifetime updates and online support. **DAVE MITCHELL**

### SPECIFICATIONS

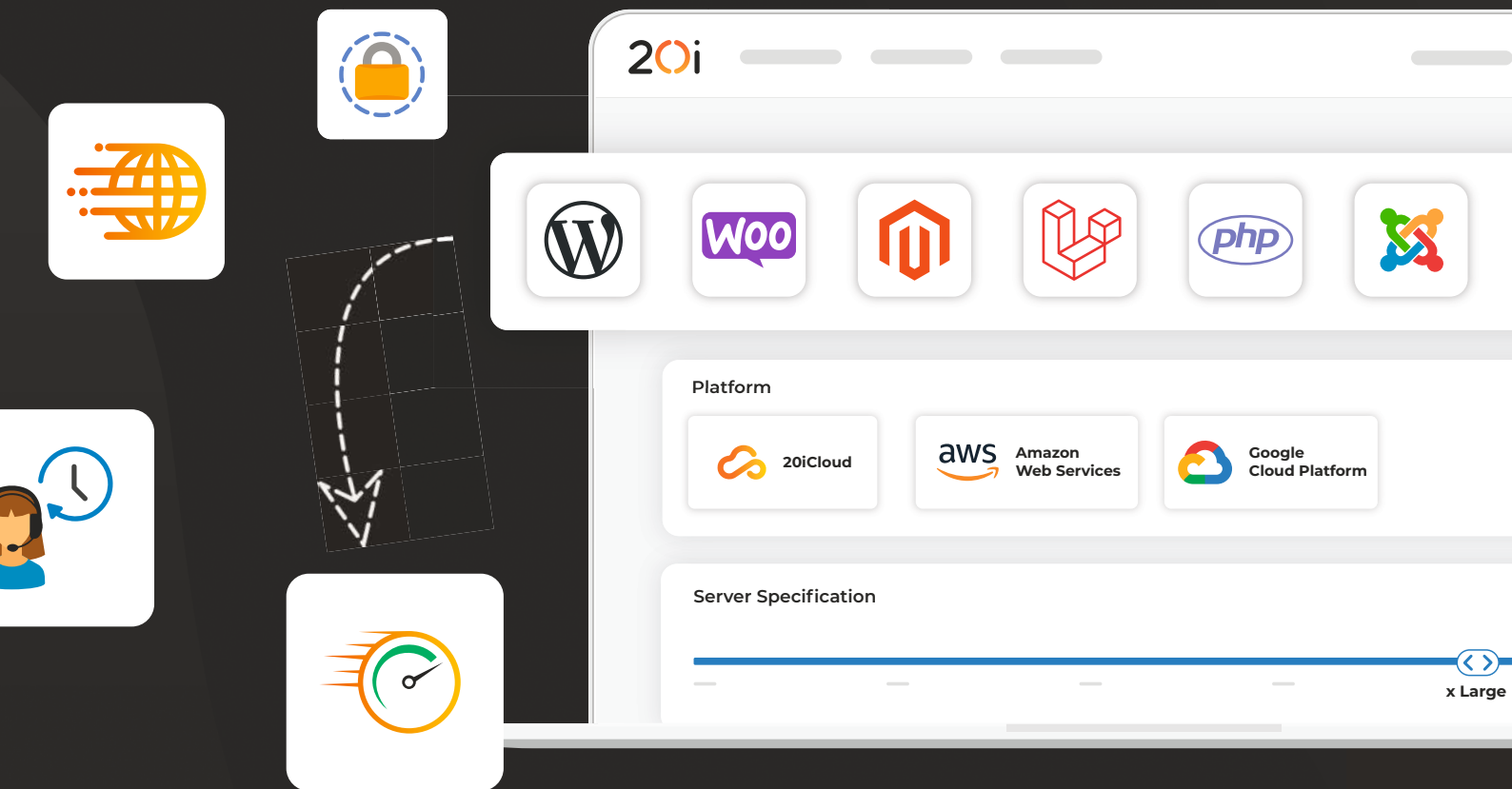
Desktop fanless chassis • 2GHz quad-core ARM Cortex A55 CPU • 4GB DDR4 RAM • 32GB SSD • 2 x 2.5GbE (WAN, LAN) • 2 x gigabit LAN • 2 x USB-A 3.2 Gen 1 • USB security dongle • HDMI • RJ-45 console port • external PSU • Android and iOS mobile apps • 130 x 110 x 30mm (WDH) • 433g • 1yr hardware warranty. **Options:** Firewalla Wi-Fi SD USB adapter, £49 exc VAT





# Best Web Host

## PC Pro Awards 2023



Build, deploy and manage all your sites with our lightning-fast, ultra-reliable Managed Cloud Hosting



[www.20i.com](http://www.20i.com) 0333 344 2720



# How to protect your business in 2024

Davey Winder reveals the biggest threats that hit businesses in 2023 and what's likely to happen next year

**O**n p34 we look at the ways in which home networks and personal devices are most likely to be attacked in 2024. But what about businesses? You might assume that cybercriminals would focus their attentions on the biggest organisations – after all, those are the ones best able to afford huge ransoms. In fact, smaller companies can and do get attacked all the time.

“Regardless of the size of the business,” said Matt Cooke, strategist at cybersecurity specialist Proofpoint, “if they have a bank account, or sensitive information to steal, they are very much at risk.” Proofpoint’s researchers have found that 72% of organisations with fewer than 500 employees have dealt with a material loss of sensitive information within the past 12 months (see [proofpoint.com](https://proofpoint.com) for more information).

Indeed, small and medium-sized businesses are prime targets for malicious actors. Recent research from cybersecurity specialist Trellix ([trellix.com](https://trellix.com)) reveals that companies with between 51 and 200 employees are the most common victims of ransomware campaigns, representing a third of all attacks in Q1 2023.

“Smaller, less prominent organisations often lack the resources to implement robust security measures, either from a financial or skill-based standpoint,” explained Trellix VP Fabien Rech.

To protect your company and data, therefore, it’s vital to be aware of the threats you’re likely to encounter, and to direct your (likely limited) resources accordingly, so as to minimise exposure to these security risks.

## ■ Phishing

One important thing to understand is that your small business will mostly face the same range of threats as larger ones. This is because, by and large, cybercriminals are creatures of habit. They will use tried and trusted methods to attack your networks and data, sometimes with an indiscriminate “spray and pray” approach, other times with carefully targeted attacks. In both cases, by far the most common threat facing businesses of all sizes is phishing.

The challenge with phishing is that it comes in many forms. Michael Skelton – a long-time *PC Pro* reader and current VP of security operations at Bugcrowd ([bugcrowd.com](https://bugcrowd.com)) – notes that, while most associated with email, phishing can equally take place via SMS, online chat services or even live telephone calls. The common theme is using social engineering to trick employees into revealing sensitive information, especially login credentials, which can then be used for further mischief.

“Once armed with this information,” Skelton explained, “cybercriminals can bypass security

measures and gain access to systems where they can initiate attacks like ransomware or data breaches.”

There is some positive news: while phishing is a widespread threat, most campaigns are far from sophisticated. Many attempted attacks can be defeated simply by recognising the red flags, such as unexpected invitations to open an untrusted attachment or log into an unfamiliar untrusted website.

“Staff cyber-awareness training is particularly important in combatting phishing,” said Jamie Akhtar, CEO and co-founder at CyberSmart ([cybersmart.co.uk](https://cybersmart.co.uk)). “It doesn’t have to cost a lot or take hours of employees’ time; a basic grounding should help them spot most threats.”

Sometimes, however, cybercriminals will target specific employees of a business – an attack type sometimes known as “spear phishing” or “whaling”. Such tailor-made attacks can be much harder to spot, and the goal might not be merely to steal information, but to trick trusted staff into literally giving away large sums of money. “Attackers impersonate executives within businesses, urging employees to quickly transfer funds from one account to another,” warned David Emm, principal security researcher at Kaspersky.

**“One important thing to understand is that your small business will mostly face the same range of threats as larger ones”**

"These emails are often expertly crafted, and due to the urgency conveyed by the scammers, targets frequently fail to question their authenticity and hand over information or transfer the funds as requested." The risk can be mitigated by implementing strict processes to cover financial transfers, such as requiring sign-off from more than one named individual in the business, and getting direct confirmation through a trusted communications channel, such as a face-to-face meeting or an internal telephone extension.

## Ransomware

When ransomware hits the news, it's normally because high-profile organisations have been hit with demands for enormous sums of cash. However, a report by *Management Today* ([managementtoday.co.uk](https://www.managementtoday.co.uk)) found that more than 60% of global ransomware attacks between January 2020 and July 2022 were on small businesses.

"Small businesses are especially at risk to ransomware attacks," noted Lewis West, head of cybersecurity at tech recruiter

horse's mouth," Aleem said. "They use various data-extraction and negotiation techniques, similar to a real-world hostage scenario. This can buy more time to contain the threat, help the business negotiate a lower ransom and help with remediation."

However, even if you do reach an agreement with the attacker, there's no guarantee that your data won't still be sold online after you've made the payment – nor indeed any real assurance that working decryption keys will actually be provided. It's far better to mitigate the ransomware risk as far as possible in the first place.

"There are a couple of things SMBs can do to protect themselves," Jamie Akhtar said. "First of all, invest in upskilling staff. Most ransomware attacks start with human error, and training will make this less likely. Second, ensure that you're using data backups for anything important – and have a plan for what to do if the worst does happen."

## Supply-chain attacks

While you may be doing all you can to protect your own business from online attacks, you have far less

observed Dirk Schrader, CISO and VP of security research with Netwrix ([netwrix.com](https://www.netwrix.com)). "One single vulnerability will give them an inroad into many IT estates."

**"Invest in upskilling staff. Most ransomware attacks start with human error, and training will make this less likely"**

There may be limits to how far you can audit and secure your tools, but being aware of the risk can help you reduce your exposure. "First of all, ensure your own cybersecurity is in order," Akhtar recommended. "Second, write



**ABOVE** Small businesses are a major target for ransomware attacks



**LEFT** Enabling 2FA might sound obvious, but it can have a huge impact for SMBs

Hamilton Barnes ([hamilton-barnes.com](https://www.hamilton-barnes.com)). "Cybercriminals know that smaller businesses are much more likely to pay the ransom, as they are not as equipped to absorb the attack as larger businesses might be."

"Where purse strings are tight, time offline is money lost," agreed Azeem Aleem, director of Northern Europe and UK for Sygnia ([sygnia.co](https://www.sygnia.co)). "Many small businesses opt to pay the ransom quickly in a knee-jerk reaction – unaware that the threat attacker may then choose to go in for a second attack, or only release some of their data."

If you do get hit, rather than paying up right away, consider engaging a security expert trained in ransomware negotiation. "These experts investigate how the threat actor gained access, often straight from the

control over the defences of your suppliers. Supply-chain attacks are growing in frequency and seriousness: indeed, what has been referred to as the biggest data theft of the year was achieved using a supply-chain attack. During the first half of 2023, the C10p ransomware group exploited a zero-day vulnerability in the MOVEit file transfer tool, used by organisations of all sizes from small businesses to government agencies, to steal data on a huge scale. It's been reported that more than 2,000 organisations were caught up in the ongoing security breaches, and more than 62 million people were impacted by data thefts.

"Cybercrooks have learned that finding and exploiting a vulnerability in a widely used software solution will give them an exponential push,"

cybersecurity requirements into RFPs and contracts with smaller suppliers."

## Fileless attacks

Fileless attacks are a type of exploit that commonly involve an adversary hijacking the existing software on a device for malicious purposes. Such attacks are called fileless because they take place in memory; for example, a fileless attack might be launched via a Windows or PowerShell script, running inside a genuine trusted application, or even on a cloud server. Often, no trace of the malicious software is written to the hard disk, either on your desktop or in the data centre.

"This lack of footprint or signature makes it hard for most antivirus software to detect a threat, and hackers are well aware of this," said Robert Smith, cybersecurity product manager at cloud services provider M247 ([m247.com](https://www.m247.com)). "This is why 70% of the malware attacks we see today are fileless and operating in the cloud."

How can you best mitigate against Fileless attacks? "Endpoint Threat Detection and Response (EDR) can provide much-needed protection to businesses," Smith said. "EDR uses behavioural analysis to monitor your data and what tasks you normally carry out on your device, and can thereby detect when there are changes to your daily activities caused by malware." Advanced EDR protection can help small businesses block



attacks that would otherwise be almost impossible to detect.

## ■ Cryptocurrency fraud

"The popularity of cryptocurrencies and their typically high transaction volumes have made cryptocurrency exchanges very attractive for small businesses," said Sygnia's Azeem Aleem. This is because they allow companies to transfer sums of money of any size very quickly, with minimal or no fees.

"Unfortunately," Aleem continued, "companies handling crypto may be targeted by tailored attacks, performed through quick, anonymous transactions, which are not easily detected until it's too late." To mitigate the attack threat, Aleem said, small businesses need to understand how these crypto attacks unfold.

Kaspersky has put together a useful resource illustrating some of the different cryptocurrency attacks (see [pcpro.link/352cryptoattacks](https://pcpro.link/352cryptoattacks)) that have taken place over the past year. These include the use of Trojanised hardware wallets, server hacks, fake Chrome extensions and clipboard-injected malware.

Overall, Kaspersky advises organisations to "treat all crypto-related offers, emails, letters and innocent questions with maximum suspicion, and always use security software tailored for crypto investments on all relevant devices".

## ■ Underinvestment in cybersecurity

The final threat category is, perhaps, the hardest to overcome – especially in times of high inflation, while businesses are facing bottom-line challenges at every turn. Simply put, the issue is a shortage of investment in cybersecurity. CyberSmart's Jamie Akhtar shares an alarming statistic: fully one-third of the small businesses surveyed for an upcoming report had either decreased their cybersecurity

**ABOVE** Treat any crypto-related email or offer with extreme suspicion

investment since the cost of living crisis in the UK, or admitted that they had never really invested in it at all.

"Economic uncertainty has made investment in cybersecurity tricky for many small businesses," Akhtar said, "but it's not an optional cost, and it doesn't have to be expensive. Many SMBs could benefit from consolidating and refining their security estate to focus on the must-haves."

And so we come back to the question: how should a small business best allocate its resources to mitigate cyberthreats? Believe it or not, the answer might not involve any new technology spending at all. Part of the solution is simply to prioritise stopping threats before they reach their intended victims. "Start with a proactive, not reactive mindset," suggested Michael Skelton. "Assume that the question is when, not if, an employee's account is going to be compromised. Then, explore the security features of your cloud-based offerings, ensuring that two-factor authentication, appropriate lockout policies and any other relevant mitigations are enabled for your organisation."

To support your defensive efforts, experts recommend a human-first

approach to cybersecurity.

"Today's attacks target people, not just technology," points out Proofpoint's Matt Cooke.

"Cybercriminals have found new ways to exploit the instincts of

curiosity and trust that lead well-intentioned people to play into the hands of the attacker."

"Culture eats technology for breakfast," agreed Rupert Lee-Browne, founder and chief executive of payments fintech Caxton ([caxton.io](https://caxton.io)). "Fundamentally, our vulnerability at the hands of the scammers is a

cultural issue. We need to build a strong culture within the business of understanding where the risks are, in order to beat the criminals."

How can that be achieved? Over to Lewis West, head of cybersecurity at Hamilton Barnes. "Training employees to recognise attackers' methods is an effective way to reduce the number of successful cyber-attacks, especially phishing attacks," said West. "Companies should be embarking on in-house training for their teams, to improve their online safety knowledge and flag the types of scenarios to which staff could fall victim: phishing, malware, ransomware, denial of service attacks and more."

Ben Aung, chief risk officer at Sage, sums up the message in three bullet points:

- "Make cybersecurity visible and part of your business goals – this includes being clear on how it relates to them, and ensuring cybersecurity is being talked about and promoted by leaders.
- "Focus on the basics – setting long and strong passwords, enabling two-factor authentication and reporting suspicious emails might sound like obvious activities, but they can have a huge impact for smaller businesses.
- "Implement an easy and quick way for people to report cybersecurity issues – a clear, consistent process reduces confusion and ensures that everyone feels safe to raise concerns and act on them. There is no such thing as over-reporting in cybersecurity."

Even though your SMB probably doesn't have the same security resources as large enterprises, you can fend off the majority of attacks by taking an intelligent approach to cybersecurity that focuses on the most common threats, and the most exploited vulnerabilities. ●

## Three threats to take seriously in 2024

### 5G networks and IoT devices

"As smart tech and 5G networks expand, hackers will have more opportunities to target vulnerable IoT devices. Small businesses can counter this threat by installing firewalls, using VPNs to encrypt traffic and regularly updating router firmware. You should also segment your network to remove single-point-of-failure vulnerabilities, and ensure all IoT devices are running the latest versions of operating systems and security tools." **Jamie Akhtar, CyberSmart**

### Advanced Persistent Threats

"Our researchers have found that threat actors appear to be scaling existing tactics seen in enterprise-targeted phishing campaigns for less robust SMB environments. These include the use of

compromised infrastructure in phishing campaigns; regional targeting by state-aligned actors for financial theft; and managed-services providers being targeted via phishing, introducing the threat of supply-chain attacks." **Matt Cooke, Proofpoint**

### AI-powered attacks

"The next evolutionary step in phishing attacks is likely to be AI-powered campaigns making full use of large language models. You can expect fraudulent communications to become more sophisticated, and more targeted at scale. You can mitigate this with regular awareness training, multi-factor authentication, and ensuring employees use direct sources for logging into corporate services."

**Michael Skelton, Bugcrowd**



# What is Web3?

The idea of a decentralised web has some attractions – but, as Steve Cassidy warns, its moment may have passed

## I've been hearing talk about Web3 for some time now – is this the next big thing?

Well, Web3 isn't exactly a single thing. It's a collection of technologies intended to allow "next-generation" websites to embrace disruptive trends and aspirant standards – or, at least, the ones that were disruptive and aspirant at the time when people were coming up with the concept.

## You make it sound like it's already out of date?

The thing about Web3 is that it focuses heavily on decentralisation, and particularly on the blockchain model that underpins cryptocurrency. That dates it as very much a pre-pandemic initiative, from the days of cheap electricity and seemingly limitless growth in digital assets.

## Does that matter? Aren't there still benefits to the Web3 approach?

A decentralisation mindset isn't a bad thing, and there's nothing inherently wrong with distributed databases. But they only solve a limited set of problems, especially for smaller players whose priority is responding quickly to external changes and trends in their local market.

Moreover, we can't ignore the fact that the very concept of the blockchain is inextricably tied into the world of cryptocurrencies – a world in which there's been very little good news of late. Bitcoin is still some 70% down on its previous high, while NFTs have proved such a bad investment that the entire sector seems to have disappeared. That's before we talk about high-profile fraud cases, and companies and nations that have banned crypto transactions altogether. It's hardly surprising that businesses aren't rushing to associate themselves with these technologies.

## Not to be confused with...

Unhelpfully, Web3 nearly shares a name with a quite different concept – the "Semantic Web", also known as Web 3.0. Originally proposed by World Wide Web inventor Tim Berners-Lee in 1999, the Semantic Web is a vision of the internet where all content is fully machine-readable – so you could, for example, write a simple program to check multiple websites and compare pricing for a particular item.

The technologies that could enable the Semantic Web exist today: HTML and XML already allow website publishers to use metadata tags to describe

items and properties, and the relationships between them. For now such tagging is mostly focused on search-engine optimisation, but future AI systems could automatically categorise and tag all types of online content, opening up vast potential for general-purpose information processing.

Even if Web3 never materialises, therefore, Web 3.0 could still become a reality. And if you're still confused, don't blame Tim Berners-Lee – he started talking about Web 3.0 back in 2006, before Bitcoin had even been invented.

## So what are we going to do – skip straight to Web4?

That may well be how things turn out. The rise of remote working has brought with it a new, different set of priorities to those that informed Web3. And if you want to talk about disruptive influences, the blockchain is old news: it's been comprehensively overtaken by AI, in all its forms and expressions. If I were a CTO planning a major reworking of my company's online presence, I'd be focusing on the direction the world is heading in now, rather than the way it looked three or four years ago.

## You mean we'll make more money building chatbots, rather than implementing crypto payments?

To be honest, it looks like most AI services are currently of quite limited use. On the other hand, even entrepreneurs with funding in the hundreds of millions can get caught out by sudden changes in the cryptocurrency environment, prompted by crises that have nothing to do with their business, or even their business sector. You'd have to be making a whole lot of money from those crypto transactions for the risk/reward calculation to look better than an investment in AI.

## Is there no part of Web3 that you'd consider worth keeping?

As I've said, decentralisation isn't a dirty word – it just needs to be applied appropriately. Perhaps the best part of Web3 is simply the broad idea of accommodating multiple payment types and sources. Leaving aside the whole Bitcoin maelstrom, a degree of abstraction and modularisation here ought to make it easier for businesses to (for example) switch between payment-processing providers. With new firms and transaction models springing up to compete with established banks and credit-card handlers, a flexible payment architecture could be a valuable asset. But that's more a remnant of the Web3 idea than a validation. ●

# SUBSCRIBE TO



## Subscribe today and get a **Earbuds Air S1** worth **£69.99** with every print subscription

- Personalise Your Buds with EarFun Audio App
- Multipoint connection function–Easy Switching Between Various Devices. Connect to two devices at a time, be it a mobile phone, tablet, smartwatch, or PC.
- Active Noise Cancellation
- Bluetooth 5.2 Offers Faster and More Stable Connection.
- Up to 30-hour Playtime: 6 Hours + 24 Hours with Charging Case.
- Fast charging, 10 Mins Charging = 2 hours Playtime
- Wireless Charging Compatible and USB-C Charging.
- Activate Voice Assistant.



**WORTH  
£69.99**

## ORDER SECURELY ONLINE



**VISIT** [magazinesdirect.com/PDV/XE93](https://magazinesdirect.com/PDV/XE93)



**CALL** 0330 333 1113 and quote code : XE93

Please allow 28 days for delivery, UK only. Future Publishing Limited reserves the right to limit offers of this kind to one per household.



**SCAN ME**



## Great reasons to subscribe...

- Benefits of subscribing to the world's handiest technology magazine include.
- Every issue of PcPro delivered direct to your door. Save up to 38% with each monthly issue.
- Get all the tips, product reviews and security updates early.

A year's worth of issues. 1 Payment. Simple.

### PRINT EDITION



**£51.99**

every 12 months,  
saving 33%

Get 12 issues of  
PcPro in print  
over 12 months

### DIGITAL EDITION



**£43.99**

every 12 months,  
saving 29%

Get 12 issues of  
PcPro in digital over  
the course of the year

**Offer closes 31/12/2023.** Offer open to new UK subscribers only. Pricing is guaranteed for the first 12 months and we will notify you in advance of any price changes. Please allow up to six weeks for delivery of your first subscription issue (up to eight weeks overseas). Your gift will be delivered separately within 60 days after your first payment has cleared. Gifts only available to subscribers on the UK mainland. Gift not available with a digital subscription. Gift colour may vary. The full subscription rate is for 12 months (13 issues) and includes postage and packaging. If the magazine ordered changes frequency per annum, we will honour the number of issues paid for, not the term of the subscription. For full terms and conditions, visit [www.magazinesdirect.com/terms](http://www.magazinesdirect.com/terms). For enquiries please call: +44 (0) 330 333 1113. Lines are open Monday- Friday 9am- 5pm UK Time or e-mail: [help@magazinesdirect.com](mailto:help@magazinesdirect.com). Calls to 0330 numbers will be charged at no more than a national landline call, and may be included in your phone provider's call bundle.

# Real world computing

Expert advice from our panel of professionals

JON HONEYBALL

## “The first thing to remember is that it’s very easy to make things significantly worse”

**When a friend asked Jon to help with a corrupt USB drive full of irreplaceable photos, there was only one solution. Plus, lessons from a trip to Naples...**

It was one of those phone calls that you immediately know isn’t going to have a happy ending. An elderly friend, who is moderately computer-literate, was telling me how she had plugged in one of her USB backup drives, and that Windows was telling her that the disk wasn’t recognised, and would she like to format it?

Fortunately, my screams of panic down the phone persuaded her that saying “yes” to this dialog box would be a bad idea. And that the best thing to do would be to unplug it. We would collect it and see what could be done.

Do I mention at this point that I asked whether the data was on any other drive? I could, but you can guess the answer: no, it wasn’t. These were the only copies of these files. And shall we take bets that these were irreplaceable family photographs? Oh look, you win.

Having got the drive into my hands, I first confirmed that, yes indeed, Windows didn’t like the drive. Nor did a Mac laptop. Which suggested that something was quite amiss. At this point, it would have been easy to simply admit defeat, say that the drive wasn’t recoverable, and allow my friend to lick her wounds. But where’s the fun in that? Clearly there was more that I could do, if I was prepared to get deep down and dirty with the drive.

The first thing to remember is that it’s very easy to make things significantly worse. With a drive like this, you don’t know what the problem is or the best route forward. So you turn to the specialist. For me, the go-to firm has always been

Ontrack (formerly known as Knoll Ontrack). I visited its facilities near London many years ago, and was amazed by the range of technical capabilities that it could bring to bear on a dead or dying drive. Or even groups of disks in RAID arrays, tape libraries and most any other form of storage. Back then, I saw its engineers take drives apart, replace damaged components, and bring the drive back to life. Having done this, Ontrack’s specialist software could scrape its way through the drive, looking for identifiable data, and then recover some or all of it to its owner.

You have to bear in mind that in these circumstances, getting anything back is considered a good outcome. Getting everything is icing on the cake, but don’t assume that perfect recovery is possible every time. Then there’s price. When you consider the time, effort and skills required to do this sort of forensic hardware and software work, it should come as no surprise that the cost of such a service is “robust”.

So it was good to know that Ontrack has a software tool called



Jon is the MD of an IT consultancy that specialises in testing and deploying kit  
[X @jonhoneyball](#)

**“In these circumstances, getting anything back is considered a good outcome”**

**BELOW EasyRecovery could help to recover files from a knackered hard disk**

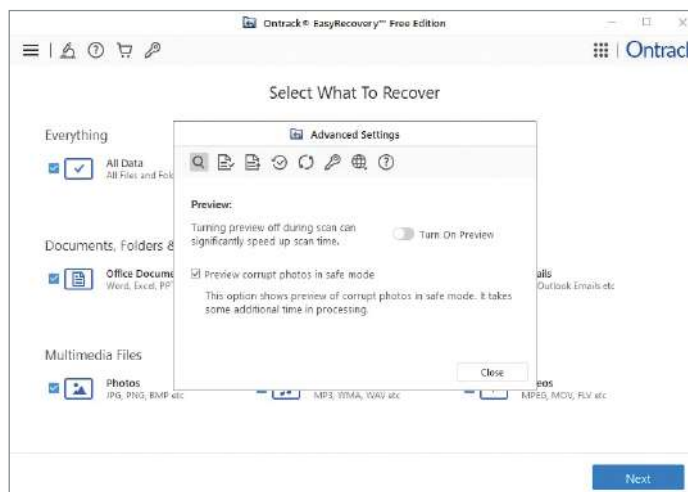
EasyRecovery that you can download for Mac or Windows, and this can go hunting around the disk looking for data, index structures and all of the other things that go to make up a disk store. This tool is available in various versions, from the Home version costing £59 per year through the Professional edition (£98 per year), to the Premium edition (£108 per year) and finally the Technician version at £196 per year.

The Home version of the product provides straightforward scanning; Professional adds support for accidentally formatted drives and corrupt data; Premium offers the ability to repair corrupt video and photo files; and finally Technician allows you to work with broken RAID volumes. There is a trial version that lets you look at the drive and see some of things that could be found, but I bought the Premium version for Windows and installed it on my Dell XPS 27 desktop.

The app offered to scan the disk, which it identified as D:, and almost immediately found a bunch of files that it thought it could recover.

That’s because it discovered a directory index structure and could read that. I used this to recover a lot of files from the disk.

I then went into the Unknown Drive mode, where it tried to scan the whole disk. This trundled along for about 35 minutes, and then came to a halt. It didn’t matter how long I left it, it wouldn’t progress. However, this mode identified a lot of files, although not really with any directory structure, and offered to bring them back for me.





**Jon Honeyball**

Opinion on Windows, Apple and everything in between – p110



**Lee Grant**

Tales from the front line of computer repair – p113



**Dr Rois Ni Thuama**

Risk analysis from RedSift's head of cyber governance – p116



**Davey Winder**

Keeping small businesses safe since 1997 – p118



**Steve Cassidy**

The wider vision on cloud and infrastructure – p120

I was most definitely making progress. But I was concerned that the app appeared to hang when it got to this particular sector on the external USB hard disk. It was time to contact Ontrack technical support.

At this point, I must state that I didn't call in any press favours or use its PR department. I simply filled in an online form for technical support as a paying customer. Within a few hours, I had a response from Peter Brown in Ontrack support, who offered up a pile of good suggestions to try. I sent in screenshots of what had happened, and got more suggestions.

At this point it became clear that the UI for the app hides many of the power features. I can see why this would be a good thing, because this is a tool aimed at the end user, even in the more powerful versions of the licence. One task was to make the software do a full surface scan of the disk, and this reported no read errors. Peter suggested that this might be a fault in the controller, which he identified as being a SATA to USB board within the casing of this external hard disk.

In the meantime, we looked at the recovered files and found, to my considerable anguish, that most, if not all, of them were unreadable. I thought we had come to a dead end, but then Peter asked me to send a few files over for him to examine. It transpired that the first 128 bits of the data header of the image files was corrupted, but that this was repairable by the image repair capabilities within the licensed version of the app that I have.

I loaded up a bunch of files, and told the app to try repairing them. Note that this is not a quick process. I had another 281 JPG files in the queue, and after a good hour it had managed to process 34 of them. A few files were marked as "advanced repair", which means it couldn't make a proper guess but could allow me to load up a similar file, maybe from the same camera, and use this to help repair the files.

My first batch trundled through, and I could then save them to local storage. A quick browse showed that it had, indeed, recovered the JPG files back to a workable, loadable state. This next batch is currently

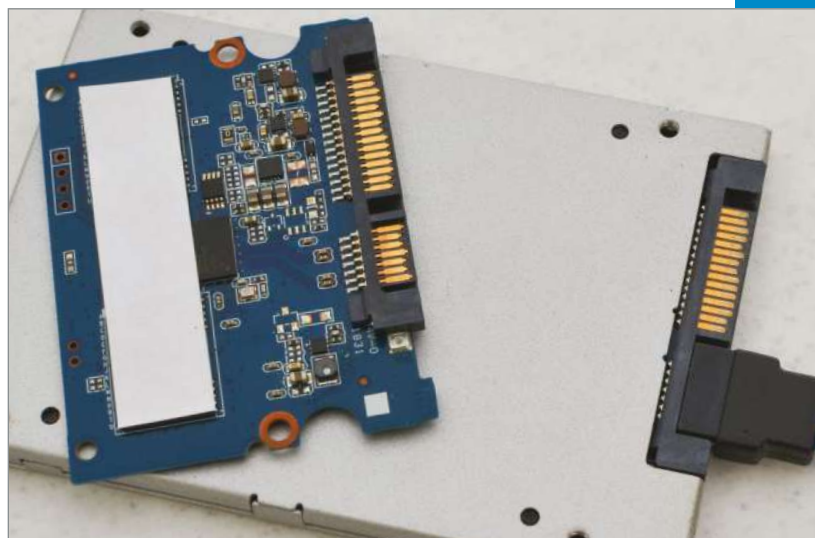
being processed, and there's probably another day or so to go through the final files.

I am therefore hopeful that I can get the majority of files back from this disk, and that all it is taking, apart from the annual software licence, is my time and patience. All of this is made possible by the combination of the EasyRecovery software and the excellent support from Ontrack, which has gone beyond what I would expect.

The software itself isn't perfect. Some parts are clunky; for example, being able to resize the window would help. As would having a working drag-and-drop for files. And, as mentioned, the UI hides away a lot of capabilities that should perhaps be more obvious.

But these are essentially minor niggles when you consider that I had gone from no files to most files over the course of a week of fiddling, aided hugely by Peter at Ontrack. The next step is somewhat more dramatic: crack open the plastic casing of this drive and extract the drive. Then see if I can mount it directly onto a SATA interface on a host PC, and allow the EasyRecovery software to have a deeper poke around the drive. The built-in SATA to USB interface might well be part of the problem, so removing that from the path is a good final step.

In the meantime, I have taken delivery of a decent cheap external USB drive, onto which I am putting



**ABOVE** The fault may have been in a SATA to USB board in the casing

**"When you have a drive that has rolled onto its back and put its legs in the air, don't panic"**

**BELOW** See Naples and (watch your phone battery) die

all versions of all the recovered files, and this can be reunited with my grateful friend.

So when you have a USB disk or other drive that has rolled onto its back and put its legs in the air, and you have that shuddering realisation that there's no other copy of this data, don't panic. There is a chance that you can get some, maybe even all, of it back. But don't make the mistake of making things worse, because that just ensures the recovery task is harder, takes longer, and will probably cost a great deal more money.

But there is one downside. Now my friends know I have Ontrack EasyRecovery, I see a few of them sidling up to me in the pub and asking if I could just try sorting out their broken USB thumb drive.

## When in roam

Last week, we took a short break to Naples in Italy. Although Naples is

famous for many things, perhaps most notably being the home of pizza, it was actually Pompeii and Herculaneum that I wanted to visit. I am old enough that I was the last year that needed Latin O-level for entrance to Oxbridge. So I managed to claw my way through this exam, pushed hard by the huge and overwhelming presence of Mr Booth, the Latin master. If I said "old school, big





billowing black gown, thunderous voice and a propensity to throw chalk at unruly boys” then you would have an accurate picture of this titan of the grammar school I attended in Chelmsford.

But despite not being good at languages, it did spark an interest in what happened to Vesuvius. And clearly it was a bucket-list trip to actually go and visit the places. I can highly recommend both, and would put Herculaneum higher than Pompeii, despite its smaller size. As a side note, much of the work at Herculaneum is funded by David Packard, of Hewlett-Packard fame.

Anyway, it was my first international trip with the iPhone 15 Pro Max. And I have three things to report that I learned on that trip.

First, the battery life seems to be considerably worse when roaming on 4G and 5G. I don’t know why, but on my return to the UK the battery consumption went back to normal.

Second, the reporting from Three about my “unlimited data” SIM (which is subject to a “fair use” (????) cap of 20GB per month) appears to be broken. 3G claimed I got through 80% of my 20GB allowance in one day, which seems unlikely. For day two, I switched to an alternative eSIM from EE, and that reported 1.01GB of data for the next two days combined.

Finally, I wanted to watch some of my entire library of the epic series *The West Wing* on the flight. But most episodes wouldn’t load, giving me an error. Seems that those I had watched before would play, but those that I hadn’t touched wouldn’t play at all. That was until I connected to the in-flight Wi-Fi service, so maybe there are some bugs here over authentication in the Apple TV app on the current 17.0.3 build.

As for Naples, what a wonderful place. The food was fabulous, too, and a welcome treat after long days of walking around incredible historical sites.

## Dashlaned hopes

You will be aware of my love of password managers, both on mobile and desktop devices. It might seem like a good idea to use the same password many times over, but this can come to bite you when there’s a hack that leaks the passwords from one of the sites you’ve visited. This is why properly randomised passwords like “wHvr45NUaDwGqf” are good, although I am veering more towards passphrases such as “Parched1-Turf-Repayment” or “Familiar4-Mocker-Debate” generated by my password manager.

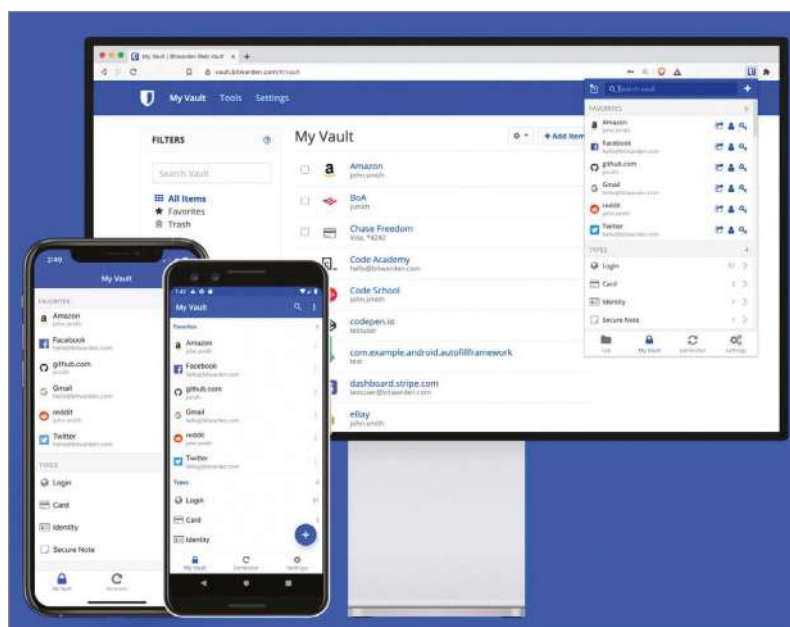
**ABOVE** My iPhone 15 Pro Max accompanied me to Italy, and taught me three things

**BELOW** Bitwarden will be my password manager of choice for the foreseeable

I prefer to keep away from password managers built into browsers or those that are bolted on by various antivirus packages, in part because I like to be in control of such an important part of my security setup. It also allows me to switch wholesale when the need arises: I used 1Password in the distant past, then moved to Dashlane. A few years ago, I moved to Bitwarden and have been very pleased with that. The apps are on all major platforms, and the browser plugins work well.

However, there’s always the nagging doubt with any free service: how is this being paid for? Bitwarden is free for personal use, and gives storage for unlimited passwords on unlimited devices. Premium is just \$1 per month, and brings in its 2FA authenticator tool, file attachments, emergency access and more. A mere \$40 per year gives you a family account for up to six users, with sharing between the family members. For business users, there are plans that offer a lot more functionality for a higher price: \$3 per month per user for teams, \$5 for the Enterprise product, and I guess this is where it makes its money.

So you can imagine my surprise when I got an email from Dashlane regarding my now dormant account. It started off with: “Over the last several years, we’ve been transforming Dashlane to better suit the people and organizations trusting us to protect their digital lives. As part of these efforts, we’re making adjustments to Dashlane Free starting this November.”



How exciting, I thought. What would it be adding to make its product even better? My hopes were dashed, or even Dashlaned. "Beginning November 7th, 2023, Free subscribers can store up to 25 passwords, rather than unlimited passwords, to access from their device of choice."

It went on to say: "You currently have 664 passwords stored in Dashlane, which means you're at or over the upcoming limit of 25 passwords. But don't worry – you won't lose any data. Starting November 7th, you can still access all your passwords, but you won't be able to store any new ones unless you upgrade your plan or remove passwords so your vault has fewer than 25."

I don't mind paying for a service, especially one that's as important as a password manager. And maybe Dashlane's hands are tied in terms of the cost of providing the service. It would be interesting to know how many customers have fewer than 25 passwords stored, but it isn't saying.

I will just keep my account rolling forward, and it can go into limbo mode for new passwords. I'm still happy with Bitwarden and will stay there for the time being, especially once I've rolled out the business plan to everyone here at the lab.

## Microsoft back to its old ways

On a related note, Microsoft is now demanding 2FA for administrator accounts for Microsoft 365, and this makes sense for all the obvious reasons. For a while, it allowed you to use either a standard 2FA such as Authy, built around open standards, or to use the new Microsoft Authenticator app. Now it appears to have changed its mind: you can only use Authenticator.

This annoys me greatly, because it's unnecessary. Sure, the Microsoft Authenticator app can do more things, but for straightforward 2FA I should be able to use the platform of my choice. It's yet more "embrace, extend and extinguish" behaviour from Microsoft, and I, for one, had hoped it was stopping this nonsense.

 jon@jonhoneyball.com

## LEE GRANT

# "This is RWC, and if this helps only one reader avoid the same pitfalls, then I'll be delighted"

**As Christmas approaches, the Ghost of Cabling Past visits Yorkshire, Virgin Media's turkey is stuffed and Lee offers real prizes to PC Pro readers**

**W**e're a little over 12 months away from the PSTN switch-off and, despite copper being old hat in many homes and businesses, I predict there will be chaos for those who attempt a VoIP transition without a plan.

The cautionary tale that follows is my own. After all, this is Real World Computing, and if this helps only one reader avoid the same pitfalls, then I'll be delighted.

During the summer, I spotted that our broadband provider, Virgin Media Business (VMB), was offering a slightly faster speed for a slightly lower price. Our shop doesn't require multi-gig synchronous phat-pipes like certain RWC contributors, because machines with smashed screens and wine dripping from USB sockets don't go online. We've functioned adequately with VMB's Zoom package, which gave around 350Mbps/sec, but the shiny offer of 440Mbps/sec for a tenner less per month was appealing. After all, our existing Hitron modem could cope with the speed, so the package tweak was more of a billing exercise, wasn't it? Ha!

VMB's sales team explained the upgrade would handle our PSTN switchover to VoIP and that this was a seamless process with no need to change our handsets. This is where I screwed up. I blindly accepted VMB's reassurance without question. I was told that a VMB technician would need to install a new router and then naively



Lee Grant and his wife have run a repair shop in West Yorkshire for over 20 years  
X @userfriendlypc

**"I screwed up. I blindly accepted VMB's reassurance without question"**

**BELOW** The great PSTN switch-off: I predict a riot

presumed that the technician would re-connect cables so I could use, as promised, the same handsets. For the second time in two paragraphs: ha!

There are many VMB-powered businesses and homes where the landlines are in a different location to the router. I've spent a good decade crawling through people's properties, searching for the master socket to troubleshoot ADSL issues. One advantage of cable broadband was placing the router in an optimum position, which was often far away from the logic-defying locations of 1980s phone sockets. In our shop, the VMB PSTN sockets are in the front of the shop while the router lives in the room at the rear, but I cared little for logistics as a VMB technician was coming to manage this.

VMB Tech-1 appeared, and I hope you'll excuse the spoiler when I say that Tech-1 and their yet-to-appear colleagues, Tech-2 and Tech-3, were nothing but utterly delightful and a credit to their employers. Tech-1 pulled our Hitron CGNV4 router, replacing it with a new Hitron Chita. Broadband was rapidly reinstated with the efficiency that one expects from a huge media corporation.

Keenly, I awaited the magical moment where Tech-1 unwrapped the wireless VoIP connectors, which plugged into our existing phone sockets, creating a walled-Wi-Fi trunk to the new router, allowing VoIPness to occur. You may imagine

that this would be a painless tech solution for the customer, but keep on imagining because, for VMB's customers, wireless VOIP connectors don't exist. Tech-1 had no provision to install any cabling from our handsets to the router's RJ-11 sockets. It's utterly my fault. I should have asked more questions of the salesperson and if your business (or home) is about to go through the same PSTN switchover, then ask exactly how the provider is going to make it work.





Due to this confusion, we requested that the PSTN sockets remained active while we sought a solution and VMB stated that we'd be notified of our VoIP switchover date. The following day, I spent several uncomfortable hours threading telephone extension leads through two rooms' worth of fire-ceiling, connecting handsets to the router in preparation for our VoIP switchover. With an unexpected twist, our notification that VMB had culled our PSTN occurred when the shop's alarm went haywire.

At that point, our shop's alarm system had a telephone-heartbeat. VMB pulled the plug before our alarm engineer could modify it, causing it to sound every 60 seconds, annoying most of Yorkshire and meaning that I couldn't leave the building as our insurance is void if the alarm isn't set. A late night for me and the alarm engineer, who could only be consoled by his sizable invoice listing an "emergency callout fee".

If you're still awake, you may be wondering why our business hadn't already migrated from PSTN to VoIP, and the answer is along of the lines of, "we're a tiny business with two employees and it all seemed a bit of a faff". For a competitive price, we got two phone lines and VMB's voicemail service. Providing that customers can call and leave a message when the line is both busy and engaged, then all is well with the world. For the third time in one article: ha!

## Beware of the Chita

When customers began to mention that their messages were unanswered, we spotted that VMB's voicemail was faulty. Like most telco voicemail systems, we dial a number (1571 or similar) and interact with the service by pressing numbers on the keypad. Our fault was that we'd connect to the voicemail and press a number on the keypad for an option. Afterwards, no other keypad input would be recognised. For example, we could press "1" to listen to a message but subsequent inputs to delete, rewind and so on were ignored.

We opened a ticket with VMB, who apologised for the inconvenience and promised a fix within 24 hours. The next time we called, the fix was scheduled for 15 minutes. The fault



**ABOVE** Virgin Media admits there have been issues with some of its Hitron routers

remained, so we installed a temporary answer machine, but unlike VMB's voicemail, it wouldn't accept messages while we were on a call with a customer.

Seemingly, VMB's solution was to remove the voicemail service from our account and then hope that re-provisioning it fixed the fault. Every time Virgin Media did this, the support ticket would automatically close and we'd receive a survey asking for feedback. VMB's support system can't re-open a ticket, so every support call generated a new one, then the same useless fix was applied and round we went again. Eventually the tickets went unanswered, promised call-backs stopped, so in desperation, we reached out via social media and connected with a lovely person whose job title at VMB should be Head of Giving a Sh\*t.

It was clear that VMB didn't understand the issue. Alison filmed herself demoing the problem and persuaded VMB to send another

**"VMB almost apologised for accusing us of obstructing a technician we'd never met"**

**BELOW** We're getting to know our local VMB technicians very well



engineer. Tech-2 arrived, saw the fault and uttered, "I can't fix that". We knew this, but needed someone in a VMB uniform to understand the fault. I listened as Tech-2 spoke to VMB's internal support team who also admitted they couldn't fix the fault.

You're a sensible person. You're reading *PC Pro* and I know that you'd expect that once Tech-2's report hit VMB's support system, it would escalate the issue, but no, the ticket was closed again. For the benefit of all concerned, I'm going to now gloss over the part where VMB suggested our handsets were to blame but

couldn't recommend a compatible replacement, and return to when Tech-3 arrived to remove the new router. They left after around an hour without changing the Hitron Chita.

Alison then received a message from VMB's "Executive" support team, who accused us of instructing Tech-4 not to swap the router. That's not a misprint. Tech-3 entered our building, not Tech-4, and eventually VMB's executive apologised for confusing support cases and almost apologised for accusing us of obstructing a technician we'd never met.

What VMB didn't appreciate is that we know many of their local technicians, including one who never stepped foot in our shop, Tech-X. They knew of the exact issue we were having and warned that VMB didn't have a fix for it. It seems Tech-X was correct. A week later, Tech-1 returned sporting a fresh Hitron CGNV4, which was unnecessary as VMB hadn't collected the original. It's one way of

offsetting its e-waste problem, I suppose. Tech-1 admitted that they didn't know if the router swap would work, but it did, instantly. Tech-X told me another local business experiencing major VoIP issues is already on its sixth Hitron Chita, and if it's been through VMB's abysmal support service, it will be as thrilled as we are.

Virgin Media has apologised for the fault and acknowledges that there's an issue with a small proportion of the Hitron Chita routers. A Virgin

Media spokesperson told *PC Pro*: “We’re aware of a technical issue that may be impacting voicemail services for a small proportion of our business customers. While our teams continue to work on a longer-term resolution, we’d encourage any customer who is experiencing difficulties accessing their voicemails to contact us and we will work to resolve this.”

Virgin Media offered no apology or explanation for the weeks of abject misery prolonged by its Byzantine business support system, nor an acknowledgment that its sales team needs to explain the PSTN switchover with a greater level of investigative clarity. If you, your business or someone you know is about to transition to VoIP, then don’t assume, like I did, and ask plenty of questions about setup and liability.

## Jingle Dell Rock

Recently, a Dell XPS 13 laptop from *PC Pro* reader Nicholas Greenfield arrived at the shop requiring a trio of niggly repairs. His PSU was outputting nothing useful, the battery had several spicy pillows and the keyboard’s efficiency had dipped well below the 26-character optimum.

Regular readers will recall that I’ve often complained that modern laptop design usually dictates that the entire top cover must be exchanged to replace the keyboards, which are plastic-welded into place. Certain YouTubers will happily reheat the plastic with a soldering iron, but I’ve seen enough melted and poorly attached keyboards to know this isn’t the way to do it. I also have a preference for not smelling as if I’ve fled a fire in a Tupperware factory.

Clearly Michael Dell has read *PC Pro*, decided that I’ve got a point and made some changes. I’m delighted to report that Nick’s keyboard was affixed with around 50 tiny screws, which reduced the cost of the repair and stopped working components going in the shredder.

Sadly, Dell only scores a B+ for this one as the keyboard’s replacement procedure included removing a glued-down cable that connects the fingerprint sensor to the motherboard. This cable is only millimetres wide

with a control IC soldered along its length; in repair terms, it was the trip hazard, which was only going to increase costs. Using an iOpener ([pcpro.link/352iopener](https://www.pcpro.co.uk/352iopener)), I softened the cable adhesive, but the IC was bonded to a vinyl heat-shield with stronger stuff. I sliced around it with a scalpel. Therefore, I publicly apologise to Nick that his laptop is 0.0001 grams heavier than specified, but the fingerprint IC does now have a double heat shield.

## FixFest 2023

At the end of September, I had the great pleasure of attending FixFest 2023 organised by Restart, Repair Café Wales and the Community Repair Network. Repairers arrived from all around the world to discuss the challenges of getting the whole of the UK fixing with an emphasis on how to engage with young people.

One of the overriding themes was how to re-adjust society’s mindset and re-normalise repair as the default option for when things break. The problem was eloquently explained by Chris McCartney from Repair Café Belfast (easily found on Facebook): “Repair is normal. Throwing things out isn’t.”

Chris has founded ten Repair Cafés in Northern Ireland and knows the transformative effect of repair on a community. As a tech repairer, it was enlightening to realise how my version of repair differs to others. I spoke with many woodworkers who fix items that are centuries old



**ABOVE** It’s Christmas Quiz time! What’s under the flap?

**BELOW** Win one of six iFixit Minnow precision screwdriver sets, courtesy of The Restart Project



and still fulfil their original function. I reflected that they’re unencumbered by the restrictive nonsense of software compatibility and that most tech repair is simply a delaying strategy before working, unwanted devices are “recycled”. It’s great to repair a PlayStation 1, but repairing a thousand of them is like building HS2: time-consuming, expensive and sod all use to most people.

It was also great to hear from Suez ([suez.com](https://www.suez.com)) and WRAP ([wrap.org.uk](https://www.wrap.org.uk)), who presented their initiatives for tackling our growing e-waste crisis and spoke with conviction on the symbiotic nature of waste-management and repair. Last of all, FixFest gave me a chance to meet some academics whose research is, frankly, mind-blowing in terms of tech sustainability, and you’ll hear more about this in the coming months.

## Prizes to be won

Finally, it’s time for this year’s Christmas Prize Quiz. Study the image above of a laptop that recently arrived for repair.

I’ve circled an unusual flap in the chassis, which concealed a clever design element.

For a chance to win one of six iFixit Minnow precision screwdriver sets, donated by those lovely (and they are lovely) people at The Restart Project ([therestartproject.org](https://www.therestartproject.org)), just answer this two-part question: what is under my flap and what is it for?

Email your answers to [lee@pcpro.co.uk](mailto:lee@pcpro.co.uk) before 24 December 2023 and I’ll pull the winners in early January. My grateful thanks to all at Restart for their generosity and to you all for continuing to support *PC Pro* while putting up with my nonsense. Alison and I wish you all a happy and peaceful Christmas.

[lee@inspirationcomputers.com](mailto:lee@inspirationcomputers.com)



**RIGHT** Repairers from all around the world gathered together at FixFest 2023



ROIS NITHUAMA

# “This was weaponised technobabble. And they were bringing out the big guns”

**If someone tells you they’ve built a quantum computer you need to ask hard questions or walk away. And treat all such “zinger” claims in the same way**

I’m not claiming that I manifested the glitch in the Air Traffic Control system at the end of the summer because I’m so deeply attuned to the natural and digital world that my worries actualised as a blip on the radar. But I might have done. Fortune, fate or actualisation intervened and, because of that glitch, it wasn’t possible for me to fly. Phew!

I say phew because, with only a few working days left to go before needing to travel to a cyber-resilience event, the organisers unilaterally changed the title of the upcoming discussion. That’s without consultation or agreement with the firm sponsoring the panel session. Or, indeed, agreement with all the panellists.

Now, that might seem odd and inconvenient, but hardly the stuff of nightmares. Until you learn that the agreed title was sensible and intelligible, whereas the revised title was none of those things. It was, as one fine wordsmith put it, “a lot of old guff”.

But wait, it gets worse. An email arrived late on Friday afternoon with a “debrief” that contained a very short list of the topics that we would be expected to cover, including “quantum technologies”. Oh boy!

Aside from the initial internal dialogue – which included such classics as “Quantum what? Huh? What on earth is going on with these organisers? Is anyone else seeing what I’m seeing?” – I was plagued by another question tumbling around my head: why now?

In particular, what recent developments in this complex field merited non-experts discussing it on a stage? More importantly, why would anyone think that people uninvolved in quantum technologies



**Rois Ni Thuama PhD is an expert in risk mitigation and head of cyber governance at Red Sift.**  
X @rois\_cyberstuff

**“I didn’t want my name anywhere near this. Not my circus, not my monkey”**

**BELOW Joe Biden looks at IBM’s quantum computer – which actually exists**

would have anything even remotely interesting to say about them? Does the audience benefit from a single panellist pontificating on matters where they can claim no real expertise? Who was looking to benefit from bamboozling or bluffing the busy attendees? How might this be written up and where would it be shared? “The panel discussed quantum technology, with panellists including...” Oh no, nope, nope, nope.

I didn’t want my name anywhere near this. Not my circus, not my monkey. I raised the issue with the organisers, they raised their voices. It got messy, PDQ. This was more than simply a change to the scheduled programming. Depending on how this was treated, this had all the markers to be a source of significant misinformation – or worse. The glitch in the ATC system worked for me.

But if I thought that this question about the state of quantum would be replaced with some other curiosity, I was wrong. If anything, it reached a higher pitch still. A week or so later at a rather grand dinner (unconnected to the previous summit), I sat close to a CEO who claimed that his firm had

developed a quantum computer. Holy mackerel! Had this guy developed a quantum computer, or did he have a computer he labelled quantum, like Calvin’s Transmogripher? Things were getting madder by the minute.

Why was the conference circuit suddenly a hotbed for people with no tech background, no qualifications in physics, mathematics, engineering or for that matter any related field, seemingly perfectly comfortable making quite serious claims about serious technology?

And if you’re at a dinner, what does it mean to say that your company had developed a quantum computer? Had this little-known business with a plucky bunch of exuberant salespeople, in fact, developed a quantum computer that surpassed IBM’s 1,000-qubit Condor? This would be *big* news! Huge. I’d have heard it on the *PC Pro* podcast, for sure.

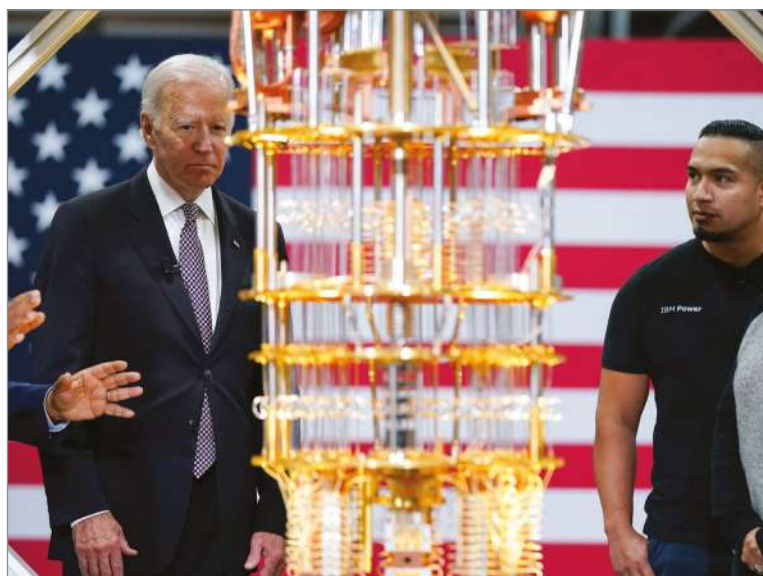
## Who cares? We all should

Full disclosure. Quantum anything is not in my bailiwick. It’s not even in my neighbourhood. My neighbourhood is the law. Not every bit of the law, but corporate, governance, contract law, white collar crime, shareholder class actions, investor protections, fraud and theft.

For our economy to function properly we need our corporations to function properly. That means that firms must operate within the laws. All of them.

Beyond the black letter of the law, working to build and preserve trust, confidence and value in the firm, lies corporate governance. These are not laws but rather a framework and set of principles that guide decision-making

within a firm. The classic definition of corporate governance that economists heavily rely on is: “the way in which suppliers of finance to corporations assure themselves of getting a return on their investment”. My favourite line, which almost never appears in the literature and almost no-one ever refers to, is the one that follows directly: “How do they (investors) make sure that managers



do not steal the capital they supply or invest it in bad projects?”

Indeed, good question. It used to be that managers might extract benefits by tunnelling company resources out via perks.

Traditionally, perks have included company jets, luxury apartments, lavish corporate entertainment and even expensive artwork. Infamously, in the case of Tyco International, there was a \$6,000 shower curtain. Six. Thousand. Dollars. Tyco's CEO Dennis Kozlowski also indulged in extravagant parties, throwing a two-million-dollar birthday bash for himself on the island of Sardinia. Two. Million. Dollars. The mind boggles.

But for businesses with unscrupulous managers, there's an easier way to extract cash. It is, of course, illegal. But when people don't mind breaking laws, they don't mind breaking laws. We know this from the data sets compiled during Bill Bratton's tenure as commissioner of the New York Police Department. His CompStat model helped to reveal that if you have 100 burglaries, you don't have 100 burglars. You have a dozen busy individuals.

The easier way to extract benefits is to invest in tools or tech that have no material benefit to the firm. A NYU law professor when speaking on the matter of Sam Bankman-Fried and FTX talked about the “weaponisation of technobabble”.

Often referred to as information asymmetry, I prefer the words of the professor. This is what I was seeing: weaponised technobabble. And they were bringing out the big guns.

Individuals with little to commend themselves in the tech area with no related expertise (physics, engineering, mathematics) championing a complex and unfolding new area of tech prepared to play babble bingo. I was, naturally, deeply suspicious. Suspicious that it might be a bad project or something much worse.

We've seen lots of bad projects in the tech space: Google Glasses, Segway, Microsoft Kin. And we've seen worse: Theranos, Juicero, OneCoin.

The problem for investors is that they might be induced to invest or to follow their investments by statements about how developed a technology is (Theranos, Juicero) or the business that they are invested in might, just might, buy into that technology themselves, leading to significant corporate waste – while potentially benefitting an individual manager in other ways.

## Quantum or quantum-ish?

Given that well-resourced, well-established businesses face a number of significant challenges in engineering, scalability, and developing quantum memory, accepting that a smaller, less well-resourced firm has cracked it seems at best highly implausible.

It brought to mind a conversation I had years ago with Brett Johnson, a guy the FBI dubbed the Original Internet Godfather. When I asked him how he'd got started, Johnson recalled watching a show that featured the lucrative trade in Beanie Babies. The blue ones were sought after; Johnson bought a grey one, dyed it, listed it as blue, and sold it for \$1,500. The buyer complained it wasn't blue. Johnson argued it was “blueish”. Maybe this guy's computer was quantum-ish? Outstanding.

Business owners and managers are allowed some latitude for confidence, particularly in the research and development phase. Without it, visions for new tools and new approaches would never be realised. Quantum is no exception.

Even when the product comes to market, pride and promotion are permitted. You may even make the claim that your product is the best in the world. Probably. We're all familiar with the careful couching of language so as not to materially mislead.

Some efforts are considered entrepreneurial zingers; they're mere puff. They evidence the bombast and confidence of energetic entrepreneurs. In the research and development phase, they're typically statements of intent, not fact. Claiming that you will build and that you have built are worlds apart, and investors should exercise caution.

## Who you gonna call? Guff-busters

It's not possible to know everything about everything but all investors, whether investing in a product or service, can take shortcuts. There's huge



**ABOVE** Elizabeth Holmes' claims about Theranos weren't backed up by reality

**“Claiming that you will build and that you have built are worlds apart”**

**BELOW** Can a Beanie Baby be considered truly blue if it's simply blue-ish?



value for investors to be able to rely on more sophisticated, technically astute businesses, entities or individuals for a shortcut to the right answer. Well-resourced firms in the tech sector would offer valuable insights.

A rough guideline would be to reference leaders in their fields. For example, there's huge value in reviewing what Dell writes about hardware, and Cisco for anything relating to networking, security and data centres, whereas you might review Nvidia's blog and statements for integrated circuits. On matters relating to quantum computing, I would begin by checking out IBM.

IBM, broadly considered the leader in quantum computing, wrote: “Quantum computers are a rapidly emerging technology.” Not long ago, in the Digital Transformation section of *Harvard Business Review*, the authors wrote “quantum computing could revolutionise everything... [but] “while they exist in the lab, general-purpose quantum computers aren't yet available”.

The operative words here are “emerging” and “could”. Not that they are; that they might. A world away from the claims I heard over dinner. More importantly, those currently wanting to discuss it or those making claims in and around the conference circuit are in my view not good actors. They are certainly not quantum experts and, like rocket science or brain surgery, this is an area that you simply can't dip into. Caveat emptor.

 [rois@redsift.io](https://twitter.com/rois@redsift.io)



DAVEY WINDER

# “Threads is possibly the worst social network I’ve ever used, and that’s saying something”

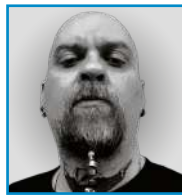
**This month Davey has been pondering privacy issues with connected cars. Plus the slow death of Twitter: if not there, then where?**

When Elon Musk decided to rebrand Twitter as X, a stupendously stupid idea even for him, the writing was on the wall. Not literally, as I seem to recall some problems with removing the Twitter signage from the HQ building, as well as that ridiculous stunt of the mega-bright giant X display on the roof. Anyhow, overnight the social network went from being one of the world’s best-known brands to X, and some months on people still refer to it as “Twitter” or, at best, “X formerly known as Twitter”.

I’m not going to get into the political leanings of Twitter under Musk, along with his frankly mystifying takes on free speech and knee-jerk business decisions. What I am going to address is the slow death of Twitter, as someone who has been using it since pretty much day one.

My @happygeek account has been active since February 2007. One of the reasons I’ve stuck around for so long is my love of online communities. My first ventures into the online world revolved around FidoNet bulletin boards, Prestel/Micronet and CIX – all places to convene with like-minded souls. I mention this because Twitter has, for the longest time, been home to one of the biggest, most active and most important information security/hacking communities online. The Musk acquisition has slowly eroded that community.

Not completely, and it’s still something I feel proud to be a part of, but it is without doubt fragmenting. Some well-known people in the business have upped and gone elsewhere. The problem is that “elsewhere” is also fragmented: BlueSky, Mastodon and Threads are the main destinations, but Facebook and LinkedIn have also mopped up some.



Davey is a journalist and consultant specialising in privacy and security issues  
X @happygeek

**“In September 2023 alone, Twitter traffic plummeted from 6.4 billion to 5.8 billion”**

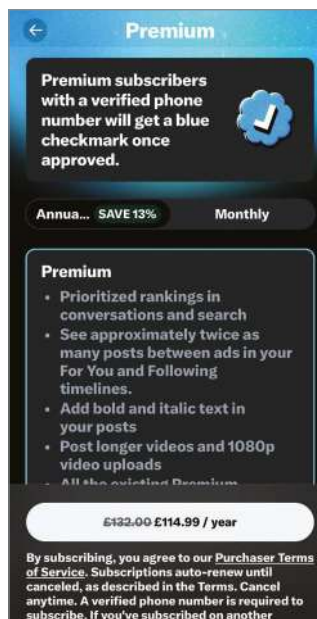
Research from analysts at Venture Smarter reveals that in September 2023 alone, Twitter traffic plummeted by half a billion visits from 6.4 billion to 5.8 billion in one month. According to Statista, in terms of active monthly users at least, Twitter/X sits at 14 out of 15 networks. Even if you remove the somewhat spurious “social network” entries such as WhatsApp, Facebook Messenger, WeChat, Telegram and YouTube to create a top ten, it sits at number nine, with only Pinterest below it. When it comes to the Statista numbers, Facebook leads the way with 2.9 billion active users, Instagram has 2 billion, TikTok 1 billion, Snapchat 750 million, and Twitter/X only has 564 million. Musk’s increasing push towards a Twitter subscription model will, in my opinion, see this decline continue.

So, the obvious question that I and a lot of others are asking is this: if not Twitter, then where? Sadly, it’s not an easy one to answer, at least from where I’m sitting. Sure, Facebook remains hugely popular, but it’s a

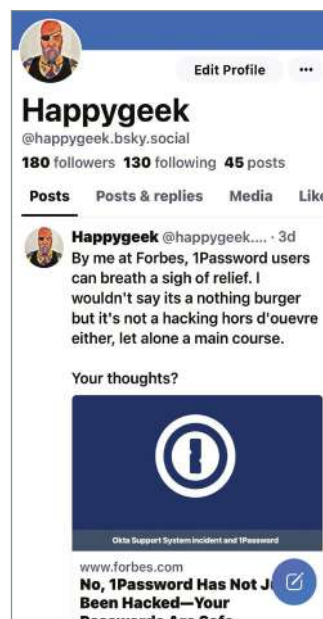
different kind of social network and one that doesn’t lend itself to quite the same type of communication and news that Twitter has traditionally provided. Ditto LinkedIn. Although LinkedIn’s business orientation has its merits, that kind of professional networking isn’t the same as community building in my book. As I’ve already mentioned, when it comes to information security at least, there are three contenders for my time and input: BlueSky, Mastodon and Threads. I have accounts at all three but spend way more time on Twitter than any of them.

Threads is quite possibly the worst social network I’ve ever used, and that’s saying something as I’ve been active online for three-and-a-half decades. You can’t use hashtags, finding information about anything is frustrating, and feeds are just random. When I have posted something, there’s no traction which, I suspect, is largely down to those two complaints. Of course, were I to spend all my time on Threads building up a following, then things could well be different. But it feels like something put together in a rush, and released as a beta product as best. Which is likely near the truth, as there was an obvious incentive to profit from the decline of Twitter. If you’re an Instagram user it may help as the two are joined at the hip. I have an Instagram account, but hardly ever visit. Anyway, if you do try it out, you can try to find me there as the\_real\_happygeek.

BlueSky, on the other hand, looks good and has a lot going for it. Not



**ABOVE** The move to a subscription model for Twitter/X is doomed to fail



**ABOVE** BlueSky has promise, but remains a work very much in progress



**ABOVE** Mastodon is not for the faint-hearted, but is worth getting to know

least that Twitter co-founder Jack Dorsey is involved at board level. It's the most Twitter-like of the alternatives, and the iOS app is easy enough to use. The downsides are the gaining traction, getting a following, post visibility issues as with Threads. I find I get more visibility on BlueSky, but it's hardly fantastic. The lack of hashtags, again, is confounding, but at least BlueSky has some options for your feed such as following, discover and popular with friends.

BlueSky makes no bones about still being a work in progress, which I like, but you can only join if you go on a waiting list or get an invite code from an existing member, which I don't. I get the grow slowly mentality, but it feels like it needs to be able to build more quickly right now. Invite codes are added to your account every few weeks, and I always have some available to hand out. I'm to be found as @happygeek on BlueSky, so look me up if you find yourself there. If you follow me on Twitter then you can keep an eye open for my regular invite code drops there.

Which just leaves Mastodon, and that's where I spend most of my time on the infosec side of social networking when I'm not using Twitter. Mastodon has been around for the longest time, but has only started gaining a large volume of members since the Musk takeover. This is especially true when it comes to infosec community members. It's a Marmite network, in that you'll either love the geeky nature of the thing or you'll hate it. Guess which side of that fence I fall on?

Mastodon is a decentralised network and it takes more tech know-how to join as you'll need to find an instance – that is, a privately run server (often around specific interests) – to join, which is then linked to others to form the broader network. Indeed, you can view postings, known as toots, from just your own instance or from all.

The interface is app-dependent; you can use it from the web, or you can use one of the many mobile apps. I use Ivory for iOS, which isn't free but is worth the small subscription cost for the ease of use combined with power user features. And talking of money, instance admins run these things out of their own pockets, for the love it. The more popular ones have seen a massive rise in members and traffic since the Musk takeover, and costs have risen accordingly. So, if you do land here, drop the admin a few quid by way of thanks.

Finding information on Mastodon is easier than it is on the others, not least as hashtags are a thing – hurrah! The infosec community is thriving, and I can be found as happygeek on the infosec.exchange instance. Or @happygeek@infosec.exchange if you want to hit me up.

### What does your car know about you?

I'm an ex-motorist and, thanks to some prudent in-car system data deletion, I have ceased to be as far as my vehicle was concerned when I sold it on. I no longer drive on health grounds, but if I did I would be concerned about the health of my vehicle from the data privacy and security perspectives.

A recent study from Mozilla, having spent 600 hours researching vehicle manufacturers' privacy practices, concluded that cars were the single worst product category it had ever looked at when it comes to privacy matters. The study ([pccpro.link/352cars](https://pccpro.link/352cars)) took a deep dive into a total of 25 different manufacturers, and the report authors say they were all "terrible at privacy and security".

How so? Well, when it came to collecting personal data, the researchers found that every single one grabbed "more personal data than necessary" and used that data "for a reason other than to operate your vehicle and manage their relationship with you". So far, so bad, and I'm guessing absolutely no surprise to PCPro readers.

Here's the thing, though. What if I said that your car is more of a data spy than your smart home assistant or your smartphone? Mozilla points out that car manufacturers have a myriad of opportunities to grab data, such as interactions with the vehicle, the



**ABOVE** Your car probably knows far more about you than is strictly necessary

**"What if I said that your car is more of a data spy than your smart home assistant?"**

**BELOW** Could electric car charging points inject malicious code into vehicles?

connected services you use while driving, third-party sources such as Google Maps that you might use and so on. If this wasn't bad enough, the researchers also determined that 84% of them share that data with service providers or data brokers. I'm surprised the number is so low, truth be told, but hey. A slightly lower number, but still way too high, is the 74% that admit to selling personal data. Only two of the 25 car brands gave all drivers the right to have personal data deleted, and those were the ones selling solely into Europe where GDPR laws apply.

What you can do about it is, erm, limited. I mean, it's not quite the same as deciding not to use a smart assistant in the home and doing all your searching online through a locked-down privacy browser. Kaspersky attempted to come up with a bunch of tips ([pccpro.link/352tips](https://pccpro.link/352tips)) to help drivers following the Mozilla report, but I have a feeling most of them won't be met with a round of applause from motorists. Top of the list is to walk or ride a bicycle, for example. This is followed by buying an old car, at least ten years old, with limited data collection potential.

The remainder, while technically accurate, aren't much better in terms of practicality: don't install the car's app on your smartphone, don't activate CarPlay or Android Auto, don't connect your car to your smartphone using Bluetooth or Wi-Fi. If you drive, then you're likely going to be monitored in one way or another, that's it, period.

As I alluded to earlier, like any other device with your data, it's wise to set what you can back to factory defaults before parting with a vehicle. By which I mean deleting your in-car satnav data,





## Continued from previous page

CarPlay or whatever other connections should be disabled and so on.

Then there are the cybersecurity risks attached to modern vehicles. Connected cars are, essentially, part of the Internet of Things. And we all know how secure that is. McAfee writes ([pcpro.link/352mcafee](https://pcpro.link/352mcafee)) about the vehicle threat landscape and warns of software vulnerabilities (that could enable a hacker to take control of, or manipulate, car systems) and insecure network interfaces (exploitable to inject malicious code), for example.

Just like any other IoT device, you should update your car's software and firmware as and when available. And just like many IoT devices, this might be easier said than done. While over-the-air updates are a thing, you'll likely find some manufacturers require the vehicle be taken to a main dealer to perform the update, and charge you for it.

But modern car security best practice runs deeper than this: it stretches out of the car and into the home or office. Like many folk, my last car had keyless starting. Unlike many folk, I didn't leave my keys on a hook by the front door where someone could use a signal booster to "grab" that key signal, unlock the car and drive off with it. Instead, I kept my keys in a Faraday cage. Well, a small box that acted as one, on my bedside table. I even had a pocketable Faraday sleeve for my keys when I was out and about. But then I'm a paranoid old codger, so there is that.

The risks don't end there, either. While I haven't personally seen any proof of concept exploits, it's far from the realms of fantasy to imagine that charging points for electric vehicles could be compromised to inject malicious code into the vehicle they're charging. Indeed, a blog at threat intelligence platform Kela ([pcpro.link/352kela](https://pcpro.link/352kela)) confirms that in January 2023 a security researcher showed how one brand of charging stations' security could be successfully and relatively easily bypassed. I expect to see this kind of threat emerge at some point, but am hopeful that manufacturers are ahead of the curve and have security teams working to mitigate any such risk.

[davey@happygeek.com](https://twitter.com/davey@happygeek.com)

## STEVE CASSIDY

# "Stop this nonsense! You've all had quite long enough to get these things right by now"

**Steve shares his list of annoying habits and out-of-date working practices that have no place in modern computing life**

**T**his month's column is simple: it's a bunch of things that people don't do that really tick me off. A diver's list of missed behaviours, abandoned opportunities and plain lack of common sense in working practices. Things you've all had quite long enough to get right by now.

## One machine, one login

Stop this nonsense! Even though I agree with anyone puzzled by the vehemence of Apple's and Microsoft's long-standing advice, that disabling the default Administrator account slams the door on hackers and the like, that shouldn't cast a huge shadow over all other account-making options and outcomes.

My standard Mac build now has two accounts for me, one for my partner, the Administrator account, and something called "Fixer". I use this because said partner is an incorrigible shutterbug, inclined to shoot first and ask questions later. Her account – and now, mine too – can't live happily on the basic boot volume of the Mac, because we both have excessive photo and video libraries. Of course, as an old fool I've long understood how to keep stuff on extra volumes: the difficulty is that not everybody blithely navigates a complete library space spread over many hard drives, when so many packages go for the default container (or even give up on local and prompt you to open the internet, instead).

So, I use "Fixer" to hack the other accounts and move their macOS Home folders to much bigger storage than the boot SSDs in our Mac Pro collection will permit. You can't pull yourself up by your bootstraps in several distinct ways if all you have is just one login (admin rights included, or otherwise).

Oh, how much time I would have saved if I had



Steve is a consultant who specialises in networks, cloud, HR and upsetting the corporate apple cart  
[@stardotpro](https://twitter.com/stardotpro)

**"I'm always the guy in the hotel check-in queue who refuses to provide my email address"**

**BELOW** Having multiple accounts makes life easier – and safer

adopted this tiny gimmick three decades ago! Multiple accounts, each with distinct sets of rights to various files and folders, many marked as administratively privileged (but not all, without jolly good reason). Even in the world of sensible, Windows-using working types, there's almost never an understanding of what actually listens out for a login request over a network, much less how names are added or removed from the list of users.

Everyone's supposed to be familiar with Windows domains – as a concept, I mean, not as in the baroque and mostly hidden internal structures and how various housekeeping or crisis-recovery activities are undertaken. But when was the last time you saw an office worker switching logins because they wanted to do something with an unknown security profile or risk on the internet?

Acting to protect your data is one of those common-sense ideas I never, ever seem to find when I'm out and about. I'm always the one guy in the hotel check-in queue who refuses to provide my email address; while the rest of the queue are staring at me like I've grown horns, the simple truth is that I've never had any trouble or backlash from withholding this type of information.



Logging in with a local user account of “surfer” is the same idea. You just don’t fill in payment details from this login, nor sign in to any deeply important personal finance or other secured sites. Lots of people see the sense in thinking securely, so why is it so few take the extra minutes needed to throw together some more logins?

## More than one disk

So, you’ve bought an SSD. Congratulations! Pick your disk-copying software carefully and you could be up and running massively quicker in next to no time.

But – there’s no need to be ashamed or shy – I do have one question to ask. What have you planned to do with that old drive you just took out? Even if you upgraded a laptop, there’s still the option of replacing the CD drive bay in most decent long-life models, using a little SATA carrier tray for that old hard disk. Cheekily, I thought the best trial of a demonstration Seagate 18TB hard drive would be to put it in a well-behaved desktop PC. It showed up in Windows 10 right away, giving the lie to the commonly held belief that NAS drives work only in NAS devices.

Actually I’m being a bit flippant there. There are certainly storage devices with firmware matching one host device, and one only. Both extremes of this condition can be found in enthusiast techie Cupboards of Shame and Garages of Despair. Drives bought to plump up a NAS, only to find they won’t mount or present their full capacity. And drives that look absolutely kosher, but which under their standard dimensions and connectors hide a totally different, some might say even perverse, software variation that won’t come out of its shell unless it sees the right controller, the right host, the right revision and so on. You can see the mortal remains of these super-selective beasts in eBay listings, trying to tempt the less wary bodger.

I can remember when the nerd community used to divide itself up by the brand of hard drive they trusted. Such vanities are a thing of the past, as are those worries that everything is timed to explode into a cloud of nanites the instant the device warranty period is over. Chances are when looking at a modern drive from a top-five brand, you can assume it will work with most motherboards.

The same assumption does not, sadly, apply to the promising but perilously diverse new world of NVMe

solid-state disks. Even assuming that because you can see a suitable mounting and connector on the motherboard doesn’t guarantee compatibility. To take one painful case in point, the various Lenovo laptops with a broad spread of different drive connection technologies, from Express Card through eSATA and internal secondary bays, may not support booting from the M.2 slot. Some deny the use of the slot for storage at all, referring to it only for add-on radio cards, and probably a pretty narrow selection of those anyhow.

Then there’s the spread of NVMe standards within the somewhat sloppy naming convention of the standard. My preference for adding solid-state storage to an older machine is to use the SATA connections, or deal strictly in very well-known and clearly documented hardware fixes. I’m thinking of those great big Dell add-on cards you can get with four NVMe slots and a cooling fan worthy of a *Quake* server – if you’re prepared to pay for them and wait for shipping from China, of course.

Adding a disk is, in any case, a good enough performance booster that there’s really no need to go all-solid state anyway. A second channel driving an old-ish spinning rust disk, which isn’t used for booting or holding the operating system, is going to resolve all manner of bottlenecks and queue uses that will otherwise

slow down any machine, no matter how many points it may score in a gamer’s league table.

Perhaps the biggest stumbling block relates to the best way to make an old drive absolutely, guaranteed, stone-cold clean of all previous use histories, so it doesn’t get grabbed by the BIOS at boot time and suddenly crops up as drive C. Here, a mug of cocoa consumed while reading about DISKPART, and the CLEAN command in particular, is time well spent.

## Turning the tables on sloppy billing

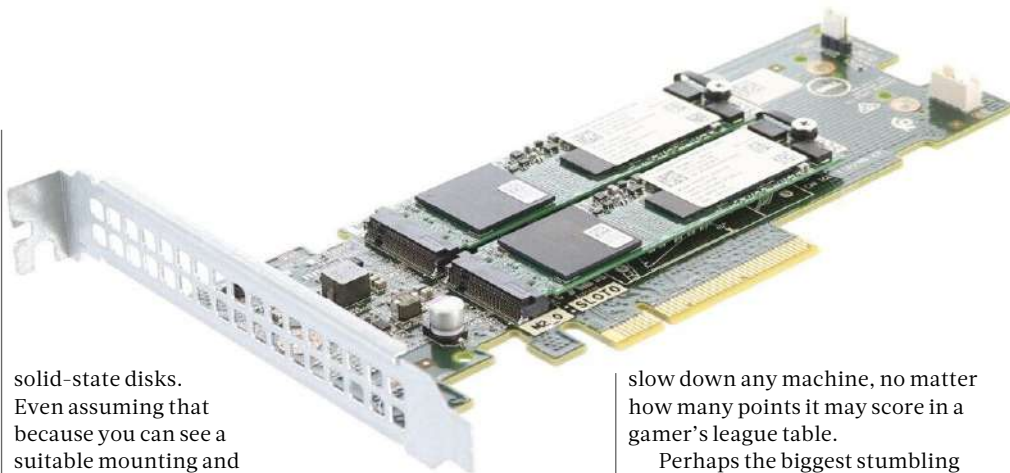
This is, I admit, almost totally a non-techie subject. Or at least, it has far more to do with infrastructure and its limitations than it does with which laptop, tablet or phone you bought.

I changed cars last month, which occasioned a phone call with my insurer. It has moved to a system which, in theory, lets you type in your payment details using the pop-up keypad on your smartphone, so no human handles your card data. It’s a great theory, and quite understandable due to the amount of to and fro that develops when changing cars; I can’t imagine a web data form that would quite do justice to the process.

The problem comes from the world of two-factor authentication (2FA), in which your registered phone becomes the presenter of some one-time transaction passwords. Except that while snaffled by the number-entry service, it can’t show you a 2FA token.

Then, to make matters worse, the line will cut out, because the call between me and the insurer passes through an undisclosed and divergent set of third-party telco companies.

The rules for these guys are very simple from their perspective. They don’t want to do anything unless the calling party (me) can be shown to have a decent level of credit before the call starts. The definition of “decent level of credit” is one stumbling block, because some networks want 25 quid off you before you use their services – even for a



**ABOVE** Some add-on cards come with four NVMe slots (and a massive cooling fan)

**“Adding a disk is a good enough performance booster there’s no need to go all-solid state”**

**BELOW** Dealing with insurers after buying a new car can be an infuriating experience



short burst of data that's going to earn them a few pence, at best. In my case, my insurance call was summarily cut off after I beeped and booped my way through the long numbers and expiry dates. The infrastructure couldn't hand on my billing data to a third party, which wasn't clearly identified up front as being in the queue for escrow monies.

The "oh well, bloody computers" response from call centres is sounding a bit tired these days. It's certainly not a matter of turning the federated-authentication service providers off and on again, it's the wilful and pointless over-invocation of data protection that causes the trouble. And next month there will be other, equally contra-logical causes of much annoyance, which will keep on going until we start applying their own rules to the processors, the services and the people on the phone.

Note I have explicitly not advocated losing your rag and shouting and screaming down the phone. I just spent four days dealing with missed Council Tax payments through the later part of the summer: not trying to dodge a single guinea, but just trying to get the council to explain why it had changed its payment account number (but not sort code), and evidently chosen an account type that caused my bank to almost throw out the transaction altogether.

Apart from being hugely satisfying, teaching the council the outcome of an account setup that avoids reporting back in online payments what its long form account name is so that the bill reminder can be matched to the email demand was a process of richly deserved sauce for the goose. Each call took three minutes of identity verification, after which the identity of the payments person on the other end was fiercely protected.

I realise that this is all at 90 degrees to the subjects the learned Mr Winder writes about, and that makes it quite difficult to line up his advice and mine in terms of practical outcomes. Personally, I see the difference being that he writes about the what: who hackers really are, what they want and how they get it. I write about the bridges they cross, the routes they take and how their influence affects the regular user – techies being a special case of regular user, in this

conversation. I am very pleased to say that on the few occasions when Davey and I are in the same presentation, the poor presenters look like they have drawn the short straw to end all short straws. We must be doing something right.

## In defence of the older computer

I've had to put down a rebellion this month: users from a long-dormant client, back in touch rather suddenly and not in the best of moods. You can't fool us, they said, we know you use the year of delivery as part of your PC naming standard, and we just had a look around our network. Most of our machines are date-stamped 16, as in 2016. That's a whole nine years ago! They really should be replaced and we're quite miffed you didn't call a few years back and set up a replacement process.

Dear users: the point at which I would have done that was deep in the heart of lockdown. I was dedicating myself to keeping contact with people to a minimum. I found that so many people had so many different reactions to physical interactions that I didn't want to second-guess anyone's preference for isolation or the opposite. In any case, as lockdown tightened, so did the stock of preferred machinery, as hard-pressed tech types had to turn to all manner of refurbishment or re-use of their own machines, just to avoid falling foul of the somewhat unpredictable nature of the delivery channels.

Besides, look at those machines: HP Compaq 8000 Elite series small-form factor desktop boxes. When I stocked up on these back in 2016, they were about a hundred quid, presenting a dual-core or sometimes quad CPU and a rather grim and utilitarian aspect. Take a look around in 2023 and you'll find plenty still



**HP Compaq 8000 Elite SFF**  
Core 2 Duo E8400 3 - HDD  
250 GB - 2GB

£799.00 new £145.00

Play with Klarna [Learn more](#)

Buy

Free delivery by 2 Nov - 3 Nov

Free 30-day returns  
12 months seller warranty

Verified refurbished

Condition

Fair

£145.00

Good

Sold out

Excellent

Sold out

**Seller comments:**

Product in good condition: slight scratches visible at more than 1 meter - Shipped within 24 to 48 hours - 12 months warranty - Keyboard and mouse not included - Original or neutral packaging

**ABOVE** The Compaq brand is still going, despite being bought by HP some years ago

**"Note I have not advocated losing your rag and shouting and screaming down the phone"**

**BELOW** SSDs aren't as short-lived as you might think



## The new fragile

We are certainly entering a new era when it comes to power delivery. My first blip cutout in some four decades had just one casualty: a newish 10GbE card in my Mac Pro server. Living before power cut; utterly dead afterwards. The older gig cards connected to the same switch all lived on unscathed. Newer isn't always better.

offered for sale as refurbished – and for roughly the same money.

That last bit is telling. We can't really say that there's been an overall smooth and predictable process of revaluation and price maintenance, especially in the inflationary period of 2021 and 2022. What we can say is that there are still buyers out there in the Compaq fan club, prepared to pay extra for stand-out models. I'm staggered, because Compaq was bought by HP several decades ago, and HP's normal habit has been to subsume brands it acquires; but here we are with a machine that's old enough to concern my absentee customer, and yet young and fast enough to hold its own, even if you have to hack about in Windows 11 to get it to accept these machines as hosts.

Perhaps the worst part of this discussion about aged machines was the way the client loved to slip from one justification to something totally unconnected. Yes, in accounting terms these machines had left the depreciation schedule some six years ago – and they were at least moderately power-hungry, though that has nothing at all to do with accounting, and everything to do with lack of wear and tear on a site that houses these machines in several Portacabins. In normal times, the more efficient and fragile machines lusted after by the rebellious users would have been replaced two or three times after "unhelpful" power oversupply situations.

This whole story is also a poke in the eye for the SSD doom-saying faction. Upgraded to SSD back in 2016, these machines have run as regular Windows workstations for nine years. If that doesn't bury the "short-lived SSD" myth, then I don't know what will.

[cassidy@well.com](mailto:cassidy@well.com)

# RETRO



Inspirational stories from computing's long-distant past

## Total recall: unearthing games that never were

For 30 years, Frank Gasking has been on the hunt for unreleased games.

David Crookes catches up with gaming's digital detective



If anyone can be called a connoisseur of videogames, it's Frank Gasking. One of his favourites is *Deadlock* for the Commodore 64. "When you look at the game and its level of detail, it's one of the best-looking titles ever seen on the computer thanks to the artwork of Robin Levy," Gasking told us. "It was made a few years before *Super Metroid* came out on the SNES and it's almost like the team from that game had seen *Deadlock* running. Of course, they hadn't."

There's a strong reason why he's so convinced that the team behind one of Nintendo's most iconic games couldn't have drawn inspiration from *Deadlock*. The latter game was never actually released. Like so many titles over the years, it was put in limbo, with the axe eventually falling in 1990. "The major stumbling block was that the game design was far too ambitious and got messy, so it lost its way," Gasking said. Yet it still remains a firm favourite.

One of Gasking's hobbies is unearthing gaming treasures, and he'll go to great lengths to track down information

about games that never saw the light of day. In some cases, that's as far as it gets: disks, cassettes and hard drives are lost, wiped or corrupted, seeing hours, days, months or even years of hard work vanish without a trace.

There are times, however, when development assets or even complete games are mined from dusty attics and basements. And when they are, the impact can be huge. "When remains of the first iteration of *Total Recall* for the Commodore 64 were recovered recently, it completely blew up around the internet due to its link to the popular film," Gasking said. "It was only an early preview without a huge amount to show but, because of the link to Arnie, it caused a bit of a stir."

**ABOVE** It took 20 years to find a copy of the highly rated but never released *Chuck Rock*

In the case of *Deadlock*, Gasking had received an email from the title's developer, Dan Phillips, in 2000 promising to share early previews of the game. Three years later, permission was granted to distribute the previews to the public, who were finally able to see how well the game had been shaping up.

"Had the team figured things out with the design and properly turned it into something playable, this really could have been something special back in 1990," Gasking said, believing it would be a true game-changer. "No doubt, it would have raised the bar on the platform." It's finds such as this that help explain his motivation.

**"When remains of the first iteration of *Total Recall* for the C64 were recovered, it completely blew up around the internet"**

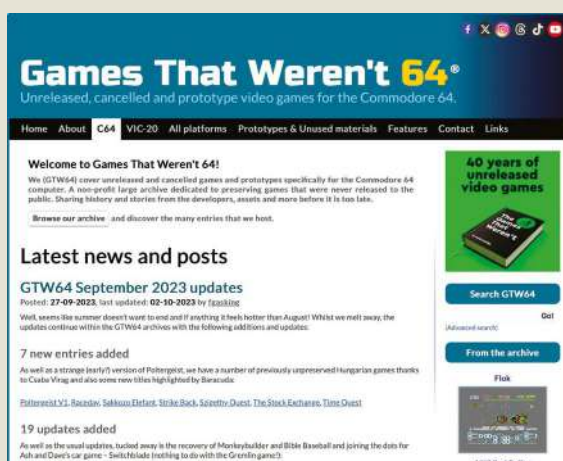
### ■ In the zone

The drive to find unreleased games began 30 years ago when Gasking, who now refers to himself as a gaming historian, read an article

by journalist Ian Osborne in the May 1993 issue of *Commodore Force* magazine. Entitled "That Was The Game That Wasn't", the piece looked at various games that had been advertised "yonks ago" but were yet to find themselves on shop shelves.

"It was the first time I had heard about the concept of unreleased games," Gasking said. "I started

**LEFT** The website contains details of unreleased titles plus downloads of rescued games



asking around to see if anyone had any of the games shown in the article, and my late friend Jason Kelk kindly put together a disk containing a few of the titles – the first one I remember loading was *Alloyrun*, which was a complete, neat sideways-scrolling shooter that had this memorable scene of a band playing in time to the music on the title screen.

“I clearly remember the buzz and excitement of playing a game that I wasn’t supposed to, but also wondering how it could be possible that complete and playable games could go to waste in this way. From that point, I wanted to try and find the other titles mentioned in the article but also look for other games that may have befallen a similar fate. Little did I know how that original article was merely scratching the surface.”

At first, leads were gained from magazines. These were the days before the internet had taken hold and Gasking had only a few contacts, primarily in the Commodore 64 scene. “At this stage I was learning of titles that had been cancelled or had disappeared without a trace,” he said.

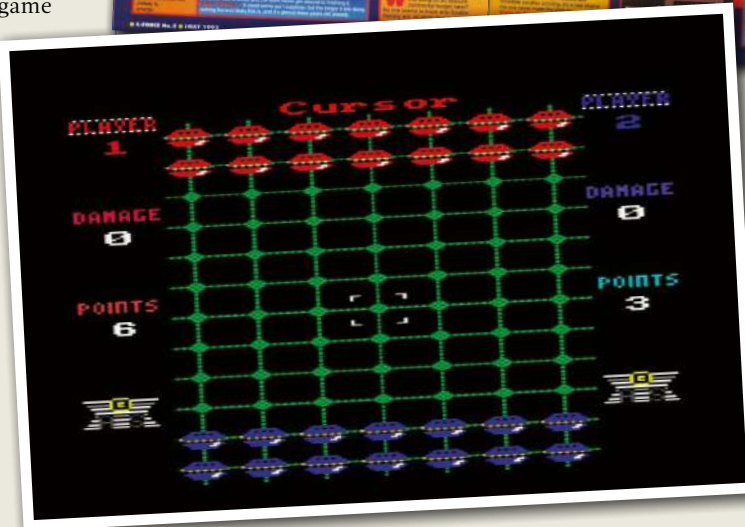
“In the early days, I was also just asking my friends and contacts via phone and letter if they knew anything more about them and if they perhaps even had copies. Thankfully a good chunk of them were out in some shape or form, and over time I started to amass a small collection of previews/full games across various disks.”

Gasking’s endeavours expanded when he wrote a regular feature for the fanzine, *Commodore Zone*. “This led to others in the scene providing titles to cover in future articles,” he said. But the hobby truly took off once he was connected to the internet at home and bagged himself some webspace. “This was around 1998-99, and I was doing an IT course at college and learning about HTML.

“I set up a basic site to cover Commodore 64 productions I was creating myself and I had a section called “Games That Weren’t”. It contained small entries on the games I’d covered in *Commodore Zone*, with downloads to previews and full games that I’d managed to find. I also started to find other cancelled games through FTP sites that contained Commodore 64 downloads.”

## ■ Making tracks

As well as sharing an assortment of goodies, which included art assets and



sound files, the website contained entries of games that were still “at large” and for which information remained scarce. By listing them, more and more people sought to assist, and ex-developers and artists got in touch via the website to offer more details. Some would send unreleased games or offer to loan disks for Gasking to preserve. There was still much work to be done.

“During the early days, I would gather credits from the magazines and through user contributions via email and then search for people in the hope they had created a personal web page or had a presence of some kind,” he recalled.

“I also looked at online directories to try and find postal addresses and I would send off typed-up letters through the post in the hope of a reply,” he continued. “This, of course, was before the days of Facebook and LinkedIn, which would dramatically change my process of trying to track people down.

“As time went on, pretty much everyone went online and could be found in some shape or form, and then election roll data started to pop up, too. The more people that appeared online, the more outreach you had to contact those involved directly, but also those who knew the people you were trying to reach out to.”

This is generally how Gasking works today, revealing the fruits of his labour on the dedicated website [gamesthatwerent.com](http://gamesthatwerent.com). Most people

are found through social media and via contacts (or contacts of contacts). In some cases, he’ll find someone’s place of work and use a company’s contact form. In other cases, he’ll continue to scour the electoral rolls. “Sometimes we don’t have much luck and then, out of the blue, the person in question discovers our page on one of their games – that’s what happened with *Total Recall*.”

One thing he won’t do is pester or make a nuisance of himself. “I will keep persevering until I hit a brick wall, where we can’t go any further and have exhausted all possible, or known, leads at that point. If we do manage to find someone involved and they don’t wish to help or be involved, then we respect their wishes, simple as that. Constantly harassing is only going to keep the door more firmly shut and, sometimes with a bit of respect and patience, people can change their minds,” he said.

## ■ Extra lives

Time can be a problem. On the one hand, Gasking and his growing team may find they just don’t have enough hours in the day to devote to chasing down developers and the numerous other people involved in past games. “It can be quite an involved process, and it’s sadly not possible to delve deep on every single entry we have in the archive, so we’ll usually spend more time on the titles that we have a particularly keen interest in,” he said.

On the other hand, it may not be an ideal time to catch a game maker’s attention. “Some may be tied up with big-name publishers and, having signed NDAs, they may not be wishing to risk anything that could affect their main source of income. That may

change at a later date if you’re lucky, though, of course, in some cases it may mean you never get to learn more about a particular title and details could be forever lost to time.”

Despite the time-consuming processes and the disappointments involved – “the process can easily turn into a bit of a rabbit hole and require a lot of detective work” – the triumphs make it all worthwhile. Visit the website today and you’ll discover close to 2,500 entries, some of which made their way into a mammoth 644-page book called

**TOP** The article in *Commodore Force* magazine that inspired Gasking

**ABOVE** You can play *Crystal X*’s lost game *Cloaker* via the GTW website

**“Sometimes it can just be the inclusion of a game that triggers the person in question to dig out their sources and finish things off”**

(what else?) *The Games That Weren't*, published by Bitmap Books.

New entries are being added all the time. Recently a bunch of Hungarian games, including an early version of *Poltergeist*, were preserved, as was an early game by Swedish coder Karl Hörnell, programmer of several games published on the budget label Players in the 1980s. Entries are also being constantly revised, helping to bridge gaps in gaming history. It all started by chasing down unreleased Commodore 64 games, but now any title on any platform is given the same treatment.

"One of the many other non-C64 games we have covered was *Half Life* on the Dreamcast," Gasking said. "Apart from the slightly dodgy loading times, this was a seriously impressive conversion that improved on the original game in many ways, and was due to be the first to have the exclusive episode of Blue Shift included as extra."

"I honestly think that had the game been developed a year or so earlier and got released before SEGA pulled the plug on the Dreamcast, then this could have helped change the platform's fortunes, or at least kept things going a little longer."

## ■ The Holy Grail

As expected, this went down a storm with retro gamers, and it's not entirely uncommon for unearthed assets to be dusted down and worked up into a complete game. Legendary 8-bit developers the Oliver Twins have proven to be dab hands at such endeavours – in 2015, they found the source code and graphics to one of their past games *Wonderland Dizzy* and enlisted a Polish *Dizzy* fan called Lukasz Kur to convert the files into a working ROM image. Such efforts are always appreciated.

"Sometimes it can just be the inclusion of an entry about a game that triggers the person in question to dig out their sources and finish things off," Gasking said. "We've seen this, for instance, for *The Wild Bunch* by Jon Wells, and also *Outrage*, which was released recently by Psytronik Software on the Commodore 64."

"Thalamus Digital has also recently expressed an interest

in finishing off a title called *Bomb*, which was being created by some ex-Domark developers (Tony and Chris West). This was triggered by a preview gameplay video we posted on our social media channels even though the previews had been on the site for almost 20 years prior to that."

Despite such successes and decades of hard work, Gasking remains motivated. Healthy sales of his book increased the level of interest in finding unreleased titles and it has lent more weight to the website. "It gives that little bit more trust when we offer to help preserve disks and other media," he said.

There are also many games still unaccounted for. "The biggest holy grail for us is *Murder!* for the Commodore 64 by U.S. Gold, which might be the one which defeats us – we've exhausted pretty much all avenues and there are very few other options now for trying to find the game," Gasking said. "Other titles include *Mire Mare* and *Bandersnatch* on the ZX Spectrum and the practically complete iteration of *Green Lantern* for the Super Nintendo. I just wish there were more hours in the day to cover and preserve everything."

## Unearthing treasures

Of all the games that he's recovered, two stick in Gasking's mind the most: *Solar Jetman* and Hi-Tec Software's *Daffy Duck*.

"Some people are probably sick to death of hearing about the recovery of *Solar Jetman*," Gasking laughed. "When I first heard that a C64 conversion of the game had been planned, I had no idea that it was anywhere near complete but, when artist Haydn Dalton got in touch to confirm he worked on it, and that it was in fact complete, I was stunned."

"He revealed who the coder was (John Buckley), though sadly both John and Haydn had nothing of the game at all after several searches. Then one day, Haydn was about to move

**ABOVE** *Daffy Duck* is one of the greatest finds: finally discover why *Zzap!64* magazine awarded it 94%!

abroad for a new role and was clearing out his house. Stuffed behind an old radiator was an old briefcase, which when opened revealed leaflets and memorabilia from computer shows in the 1990s.

"Inside were two disks, with labels indicating that they contained a build of *Solar Jetman*, along with a disk containing graphical assets. Haydn suggests this must have been a build they took to a show and was forgotten about. He duly sent the disks down to me via secure post, and it wasn't long before I was seeing his loading screen pop up on the screen with a wonderful piece of Geoff Follin music playing."

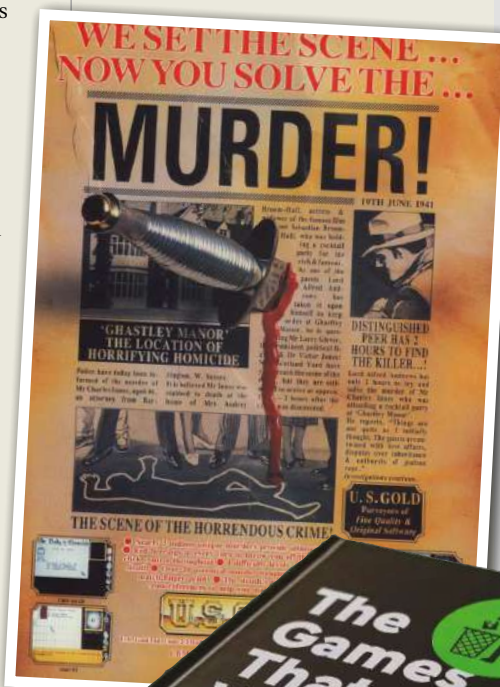
"I still remember being in shock at seeing this glorious NES conversion running for the first time, after never seeing even a screenshot of it in the press at the time."

*Daffy Duck* was also presumed lost, with Gasking having searched for the game for a staggering 18 years. "There had been many fake reports of people owning prototypes, but the developers that we managed to track down no longer had anything of the game. Even Hi-Tec's owner Dave Palmer couldn't find anything (although they did find a build of *Bugs Bunny: Private Detective* to put up on the site).

"When all seemed lost, I had decided to cover the game one last time for my book. I got in touch again with artist Ashley Routledge to ask some questions and mentioned the possibility of finding something of the game after all this time. I just expected Ashley to cover our previous searches with him and how it hadn't been successful, but then he surprised me by saying that he'd recently spotted his disks at the back of his attic."

Having offered to preserve Routledge's disks, Gasking went to collect them. "Ashley had forgotten that his coding partner Dave Saunders had given him a full set of backups of all his code and it included all of the source code to *Daffy Duck*."

"I remember seeing these disks with Ash and Dave, and Dave turning to me and saying, 'I think you've struck gold here!' We certainly did, and after a few months of hard work with Martin Pugh and David Simmons, the game was fully re-built, tested and released (finally!) in 2015." ●



**RIGHT** Despite ads such as this, *Murder!* for the C64 was never released – and has never been found

**RIGHT** *The Games That Weren't* book was recently reprinted and can be purchased from [pcpro.link/352book](http://pcpro.link/352book)

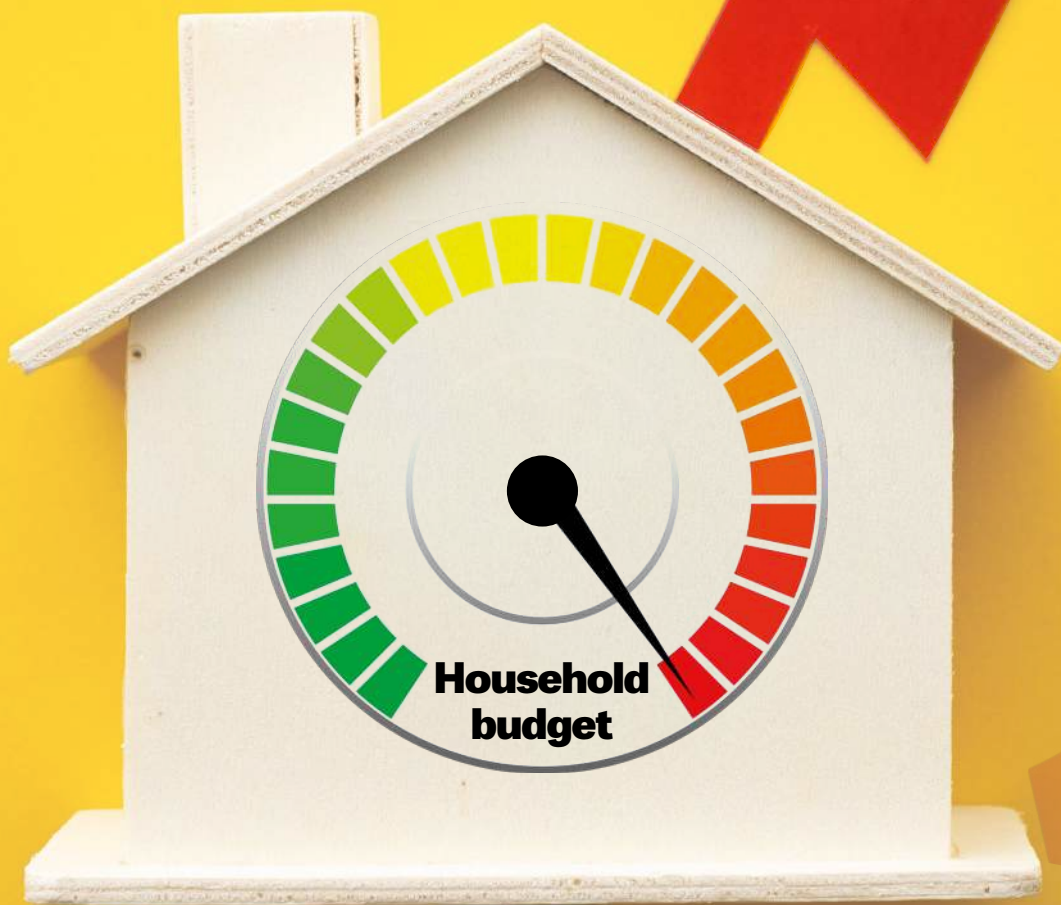


# Futures

We explore the trends and technologies that are set to shape the future

## The British startups reducing our cost of living

**Nicole Kobie** reveals the startups building tools to cut energy use, reduce bills and find help for those who need it



**I**t's expensive to be British these days, with the two-year-long cost of living crisis continuing to bite. How tough is the situation?

Energy prices spiked when Russia invaded Ukraine, with average bills climbing 27%. Inflation peaked at 11% in October 2022, but remains high at almost 7% in September 2023, well above comparable economies in Europe or the US, with the cost of food up 12%.

The Bank of England has responded the only way it knows how, hiking interest rates to 5.25%, adding to the pressure for those with mortgages. At the same time, household incomes are down in real terms by 4%, and those with the lowest incomes when this all started are among the worst hit, with fewer savings and less financial room to manoeuvre.

How can startups help? Digital tools can only do so much, and you may be tired of downloading yet another app or signing up for another web portal, but with a bit of effort you can save real money. Here's how.

## ■ Make switching easier

As many companies stop mailing paper bills in favour of digital updates, it's easy to miss key information such as increases, end-of-contract warnings and subscription continuations.

That's where Nous wants to help ([nous.co](https://nous.co)). This new app pulls in your bills data from your inbox, analyses it via AI and makes suggestions of where to switch tariffs, providers and the like, as well as warning you when a contract is up or a subscription is about to be extended. When Nous spots a better deal, it lets you know when to make the switch and uses open banking tools to automate as much of the process as possible. "It's an intelligent agent that manages your bills," said Greg Marsh, co-founder and CEO. "Nous sits in your pocket reading this for you."

He added: "Lots of people are on top of [their bills] – and well done them. But this is for the rest of us."

The idea for Nous came during the pandemic, when Marsh got a call from an energy provider about overpaying. He had plenty time on his hands to talk through the various options and research alternative suppliers, but realised that usually isn't the case. "I had this sense that this was all wrong," he said. So he set about building a "consumer champion" app, made possible by the arrival of open banking as well as large-language AI

models, which Nous makes extensive use of to read through bill data. "It's a practical example of how generative AI can help people," he said.

So far, Nous can look at broadband, mobile, energy providers and the like, and is set to add mortgages as well. The app identifies an average £480 in savings per household over a year. "The amounts saved are material – this isn't 'coins behind the sofa'," said Marsh.

Most apps of this style are funded via commissions or affiliate payments. Nous returns the cash from these kickbacks to its members. At the moment, the beta for Nous is free, but it will eventually come with a monthly charge; Marsh expects it to be in the £5-£7 range. Alternatively, companies can sign up with Nous to offer it as a benefit to employees.

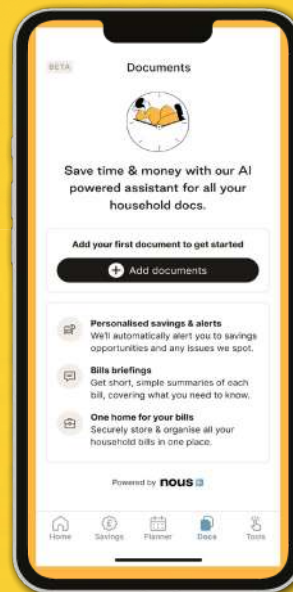
## ■ Reduce energy costs

Energy bills in the UK have risen, on average, by more than a third, with many people facing much bigger bill shock than even that. Switching providers can help, in particular those on variable tariffs (Citizens Advice has tips at [pcpro.link/352advice](https://pcpro.link/352advice)). Tech-savvy suppliers such as Octopus offer ways to reduce your bill by timing energy use to times of low demand, though you'll need a smart meter.

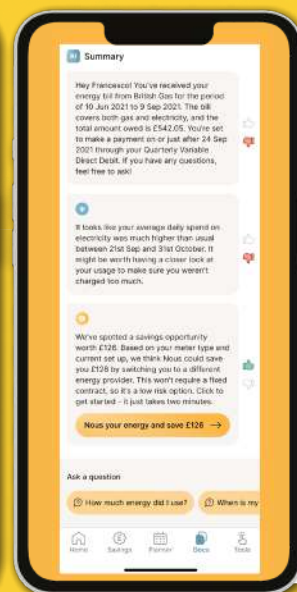
Beyond that, there are plenty of ways to slash pounds from electricity and heating bills, but without data it's difficult to know where to start. That's where startup Loop comes in ([loop.homes](https://loop.homes)). This free app links to your smart meter, pulling in as much as a year of data to crunch through and make recommendations, saving an average of 15% on energy use. "If we can make the way we use energy easier to comprehend and digest, it helps reduce usage," said Steve Buckley, co-founder and head of data science.

It isn't possible to see exactly what device is drawing the most power, but the half-hour increments for data make it easier to see when you're using the most energy. You can then use this information to unearth the worst culprits, spotting "phantom loads" such as heating an empty room or leaving an appliance running overnight. Loop also lets you see the impact of any changes – stop heating empty rooms, insulate a boiler, then watch your usage tick down along with your bills.

Loop was set up by renewables



**ABOVE** Nous uses AI to analyse your bill data and suggest possible savings



company Low Carbon, and can also offer advice about installing solar panels. It's better to use your solar power rather than sell it back to the grid, says Buckley, as selling earns significantly less than buying extra energy at peak times. A home battery changes the picture, as you can draw down at cheap times and use it whenever needed, but this requires additional upfront costs.

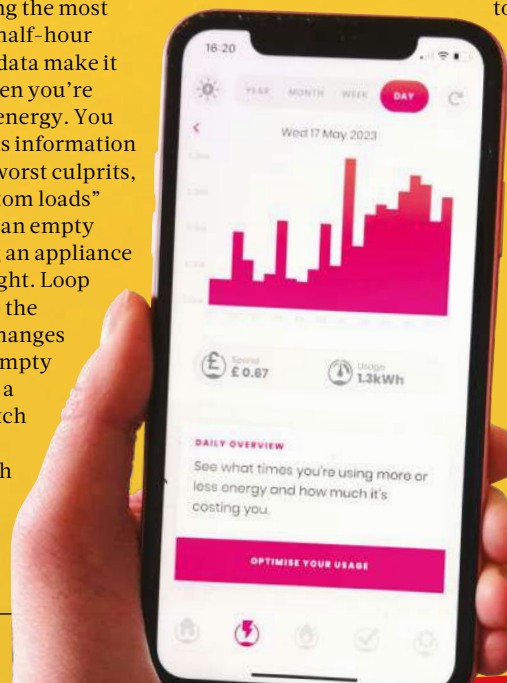
**"If we can make the way we use energy easier to comprehend and digest, it helps reduce usage"**

## ■ Money for those who need it most

Cutting costs is one side of the coin, but many households simply need more cash. There's always the gig economy, and reports suggest a rise in signups for workers since inflation began to rise, with research from Total Jobs suggesting that one in six adults had taken on extra work since the crisis began. But not everyone can take on extra work – more than a million Brits already have two or more jobs – and plenty of people are unable to work for myriad reasons.

There is help available, but you need to know where to look. That's where Lightning Reach comes in ([lightningreach.org](https://lightningreach.org)). Started by Ren Yi Hooi during the pandemic, this is a mobile-first web portal that lets users enter their personal details and find financial support from a wide range of sources, be it local authorities, the military, charities and even utility companies – more than 1,600 schemes are listed, offering benefits, grants and discounts on bills to those in need. "I realised how complicated it can be for people to access support, because it's a very fragmented system," said Yi Hooi. "People aren't usually

**BELOW** The free app Loop has saved users an average of 15% on their energy usage



aware of things like charitable grants that support individuals.”

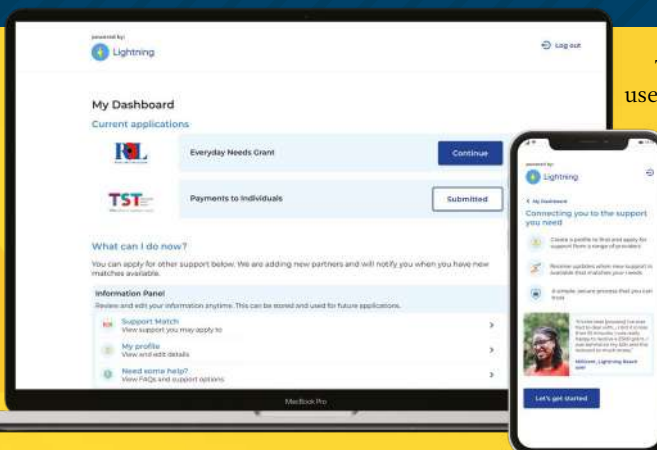
For example, certain industries offer support. It's well known that there are grants available to military veterans, she notes, less known that they're also open to people actively in the military. Likewise teacher grants can be accessed by teaching assistants. People in specific circumstances might have support designed for them, such as victims of domestic abuse. And some utilities offer social tariffs, helping to reduce bills. Yi Hooi says an average user is matched with 20 to 30 schemes, though they need to check terms to see exactly which they can apply for.

The aim is not only to make it easier to find such support, but also to apply for it. Some applications can be made directly via Lightning Reach, saving typing and uploading evidence documents. “They tend to have really long complicated forms that people might struggle with,” said Yi Hooi – and they have to do it for every organisation they apply to, sometimes not earning any support if they turn out not to fit requirements. “It felt like there was an opportunity to use technology to help streamline that process and make it a lot easier for people to find support that was suitable for them, but also to apply for it without having to repeat that information many times.”

Not all charities or public sector organisations are as tech-savvy as we'd like, meaning they use dated techniques. That costs time for users as well as administrators who have to process applications. “Lots of people are doing great work, but there are a lot of inefficiencies in the process,” said Yi Hooi. “They're spending lots of time on administration trying to collect things like bank statements from people to understand their financial circumstances and verify they are eligible.”

Lightning Reach uses tools such as open banking and ID verification to help reduce paperwork. That may sound small, but it adds up. “Using open banking, some of our partners have found they can save easily an hour and a half per application up to 70% of the time, because they're not poring through a whole bunch of PDFs and screenshot of someone's financial situation,” she said.

The portal is mobile first to make it easy to use where and when suits, with the realisation that many people short on cash won't necessarily have a laptop. Given there's still stigma around financial assistance, Yi Hooi also believes that an online form enables people to seek support even if they wouldn't feel comfortable



**ABOVE** Lightning Reach lets users find financial support from a range of sources

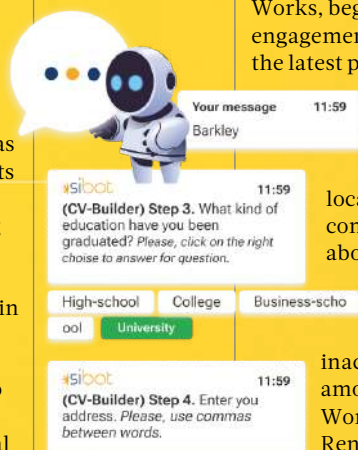
calling an organisation on the phone. To date, more than 70,000 people have registered on the portal, and have been helped with more than £6 million in financial support. It's likely those numbers will rise.

## ■ Chatbot for charity

Not all help is financial. Mendee Digital is a digital consultancy that builds tools to help people, rather than sell things. In the summer, it was one of seven startups to receive grants from the Mayor of London for tech ideas to help during the cost of living crisis for its chatbot, SiBot.

Like Lightning Reach, SiBot aims to make it easier for the people most in need to access support. The chatbot helps users find support based on their profile and location, using AI to match up their needs with the right charity to help. On the organisational side, SiBot helps charities and non-profits to manage requests and automate data collection necessary for reporting to donors.

The idea stemmed from co-founder Alex Choybsonov's own experience as a refugee. “When you find yourself in a new country, without knowing the language, devoid of friends, and having to start everything from scratch, it can be incredibly challenging,” he said. “There's a profound uncertainty about where to go or whom to ask for assistance.”



**ABOVE** SiBot uses AI to match users with the right charity for their needs

This is where AI can actually be useful, he adds. “I believe that AI, in its current capacity, has the potential to bridge that gap in support that many individuals – not just refugees, but also the homeless and others seeking assistance from charities – profoundly require.”

## ■ Keeping a roof over your head

George Unsworth used to work in the housing sector, so saw first hand how poor existing

systems are at helping at-risk tenants. “There was no consideration of the higher access and support needs that different groups, especially the more digitally excluded, require,” he said.

To address that, he founded Mortar Works, beginning with doorstep engagement projects during Covid; the latest project, Rent Response, also won funding from the Mayor of London. This tool was built after asking housing associations,

local authorities and community advice services about the challenges they faced getting help to vulnerable tenants – and poorly made forms and inaccessible advice were key among the hurdles. So Mortar Works fixed them. “We created Rent Response as a framework

of templates and tools that can be easily tailored to identify those in financial risk and to prioritise those most vulnerable with access to the most appropriate form of support,” said Unsworth.

It may sound simple, but poorly made digital tools – be they apps or websites – are keeping people from getting the help they need, whether in housing or financial support or other assistance. This is a place where startups and more established companies can actually help, be it an app to understand the data spat out by a smart meter, AI for reading impenetrable bills and their terms, or ways to navigate the complicated, fragmented network of support on offer from government and charities. “Designing better experiences and outcomes for the end-user is something that our service providers desperately need,” said Unsworth.

Help is available, and tools such as these can make it easier to find and access for those who need it most. And anything that makes the cost of living crisis less painful is a great use of tech. ●

**“Poorly made digital tools – be they apps or websites – are keeping people from getting the help they need”**





# Lego-loving Jon Honeyball harks back to the old days when things made sense

**I** can stop any time I like. It's under control. It's not running my life. While it would hopefully surprise you were I to admit to a serious drugs habit, I confess my particular poison is Lego.

I only got into Lego a few years ago. I never grew up on it, being more fascinated by how computers and networks worked. Sometimes this was frustrating: anyone who wrote programs for Windows 2 using the SDK and C compiler will remember the masochistic pleasure of writing your own WinMain() handler to dispatch messages around the various apps that were running. And how this was all undocumented, with a total reliance on the seminal *Programming Windows* book by Petzold. Then came the GUI programming languages from Borland and Microsoft's own Visual Basic. Suddenly the building block approach to creating solutions made sense.

Recently, however, computing's foundations have begun to shift. The tools haven't kept up with the needs of those who want to dabble, despite the best efforts of Apple and Microsoft. I've built bits and pieces, but there has never been the sense of completion that we had back then.

Perhaps this is why I turned to little plastic bricks. Taking many thousands of blocks, pegs, connecting rods and so forth, and following precise step-by-step instructions to create something tangible and three-dimensional, has its own unique pleasure. Once you've done enough, and I'm now on the high side of 50 kits, you start to learn the underlying logic and structure to the way Lego designs things. There are rules that you don't appreciate as a beginner, but start to notice as you gain experience. If you turn to our Hot Hardware of the Year feature on p26, you'll see I have a particular love for mechanical models – cars, trucks, bikes and even Concorde.

In the process, I have made mistakes. Usually discovered when the wheels don't turn because the gearbox has been built with some parts incorrectly inserted. Then comes the bittersweet effort to try to get back inside the model without taking everything apart to make the fix. It's challenging, but very satisfying when it all works.

If only I could find such satisfaction from modern-day computing. Recent years have been dominated by the rise, and hopefully fall, of Bitcoin, blockchain, NFTs and other digital dalliances. Then came 2023, the year when LLMs and ChatGPT surged to the fore. Some of this AI work is astonishing – just check out the images that Barry makes for the weekly *PC Pro* podcast. LLMs and ChatGPT tools can create almost convincing wordage at a speed that boggles the mind.

But the ground is shaking under the world of AI. Take a handful of days in mid-November. First came the resignation of Ed Newton-Rex, the lead of the audio team at Stability AI. A long tweet detailed his concerns with the widely held belief that “fair use” in copyright terms applies to such AI-generated works. He maintains that it doesn't, because the resultant audio (or video or picture) can directly compete with the original material that was used to train the models. And he was sufficiently concerned about this to resign his position.

A couple of days later, Sam Altman was fired from OpenAI, with Greg Brockman, president and co-founder, resigning soon after in protest. It seemed the board would be ousted, with Altman and Brockman returning, but that plan fell apart. Instead, OpenAI's co-founders would lead an all-new AI research team at Microsoft, with many disgruntled OpenAI employees expected to follow suit.

Although Altman ended up back at OpenAI after the board caved in, this was a wise move – Microsoft didn't want Altman and Brockman to head to rivals, after all – but Microsoft would have needed to play nice with OpenAI if it did install a new leadership team. I wasn't at all surprised to read a Satya Nadella tweet in the midst of the crisis stating that Microsoft would “remain committed to our partnership”.

This is important, as Microsoft owns a whole chunk of OpenAI, and its technology is critical to Microsoft's rapid deployment of a world of Copilot technologies across its estate. I've read that Microsoft's \$10 billion investment

**“LLMs and ChatGPT tools can create almost convincing wordage at a speed that boggles the mind. But the ground is shaking under the world of AI”**

gives it 75% of OpenAI's profits until the investment is paid off, at which point Microsoft gets 49% of OpenAI.

But here is the problem. This is a huge rush into the unknown, and even the biggest players in this space are susceptible to sudden change. Who knows what will have happened by the time you read this, let alone 2024?

I just hark back to the earlier, easier and more understandable days of computing. Much like my time with Lego, I know what it does, I can see how it's supposed to go together, and I value the time I spend with it because it takes me away from the day-to-day complexity and confusion of the modern world. I need less noise like Bitcoin, blockchain, ChatGPT and LLMs in my life, not more.

■ **Jon Honeyball is a contributing editor to *PC Pro*. He is happiest when not standing on a Lego brick by mistake. Email [jon@jonhoneyball.com](mailto:jon@jonhoneyball.com)**



# HYPER LIQUID PCs

Custom Water Cooled PCs



**Order today!**

✉ [sales@cyberpowersystem.co.uk](mailto:sales@cyberpowersystem.co.uk) ☎ 03333-237776

**Follow Us!**

Visit our website!










All information correct at the time of printing. Subject to change.

PHONE SYSTEM | VIDEO | LIVE CHAT

# CONNECT YOUR TEAM & CUSTOMERS

**Remote-enable** and **future-proof**  
your business:

-  Hosted PBX or self-managed
-  Video conferencing
-  Website Live Chat
-  WhatsApp & Facebook integration
-  Call center solution
-  iOS/Android and Web apps
-  Microsoft 365 integration



 Try it FREE! [WWW.3CX.COM](https://www.3cx.com)

